LABOR CABINET
Department of Workplace Standards
Division of Occupational Safety and Health Compliance
Division of Occupational Safety and Health Education and Training

803 KAR 2:403
Occupational Health and Environmental Controls

RELATES TO: KRS 338.051, KRS 338.061; 29 CFR 1926.50-.66
STATUTORY AUTHORITY: KRS 338.051(3), KRS 338.061; 29 CFR 1926.50-.66
NECESSITY, FUNCTION, AND CONFORMITY: KRS 338.051 (3) authorizes the Kentucky Occupational Safety and Health Standards Board to adopt and promulgate occupational safety and health administrative regulations. KRS 338.061 (2) provides that the Board may incorporate by reference established federal standards and national consensus standards. The following administrative regulation contains those standards to be enforced by the Division of Occupational Safety and Health Compliance in the area of construction.

Section 1. Definitions:

(1) ***"Area Director"*** means Director, Division of Occupational Safety and Health, Kentucky Labor Cabinet;

(2) ***"Assistant Secretary"*** means Secretary of Labor, Kentucky Labor Cabinet;

(3) ***"U.S. Department of Labor"*** means Kentucky Labor Cabinet or U.S. Department of Labor.

Section 2. Incorporation by reference.

(1) The following material is incorporated by reference:

(a) 29 CFR Part 1926.50-.66, Subpart D, "Environmental Controls," revised as of July 1, 1997, published by the Office of the Federal Register, National Archives and Records Services, General Services Administration.

(b) Revisions to 29 CFR 1926.57, "Ventilation", as published in Federal Register, Volume 63, Number 5, January 8, 1998, are incorporated by reference.

(c) Revisions to 29 CFR 1926.60, "Methylenedianiline", as published in Federal Register, Volume 63, Number 5, January 8, 1998, are incorporated by reference.

(d) Revisions to 29 CFR 1926.62, "Lead", as published in Federal Register, Volume 63, Number 5, January 8, 1998, are incorporated by reference.

(2) This material may be inspected, copied, or obtained at Kentucky Labor Cabinet, Division of Education and Training, 1047 U.S. 127 South, Suite 4, Frankfort, Kentucky 40601. Office hours are 8 a.m. - 4:30 p.m. (ET), Monday through Friday.

Subpart D
Occupational Health and Environmental Controls

29 CFR 1926.50
MEDICAL SERVICES AND FIRST AID

(STD 1-8.2)

(a) The employer shall insure the availability of medical personnel for advice and consultation on matters of occupational health.

(b) Provisions shall be made prior to commencement of the project for prompt medical attention in case of serious injury.

(c) In the absence of an infirmary, clinic, hospital, or physician, that is reasonably accessible in terms of time and distance to the worksite, which is available for the treatment of injured employees, a person who has a valid certificate in first-aid training from the U.S. Bureau of Mines, the American Red Cross, or equivalent training that can be verified by documentary evidence, shall be available at the worksite to render first aid.

(d)(1) First-aid supplies approved by the consulting physician shall be easily accessible when required.

(2) The first-aid kit shall consist of materials approved by the consulting physician in a weatherproof container with individual sealed packages for each type of item. The contents of the first-aid kit shall be checked by the employer before being sent out on each job and at least weekly on each job to ensure that the expended items are replaced.

(e) Proper equipment for prompt transportation of the injured person to a physician or hospital, or a communication system for contacting necessary ambulance service, shall be provided.

(f) The telephone numbers of the physicians, hospitals, or ambulances shall be conspicuously posted.

(g) Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.

29 CFR 1926.51
SANITATION

(a) Potable water.

(1) An adequate supply of potable water shall be provided in all places of employment.

(2) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(3) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(4) The common drinking cup is prohibited.

(5) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(6) Potable water means water which meets the quality standards prescribed in the U.S. Public Health Service Drinking Water Standards, published in 42 CFR part 72, or water which is approved for drinking purposes by the State or local authority having jurisdiction.

(b) Nonpotable water.

(1) Outlets for nonpotable water, such as water for industrial or firefighting purposes only, shall be identified by signs meeting the requirements of Subpart G of this part, to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(2) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(c) Toilets at construction jobsites.

(1) Toilets shall be provided for employees according to the following table:

Table D-1

Number of employees	
20 or less	1.
20 or more	1 toilet seat and 1 urinal per 40 workers.
200 or more	1 toilet seat and 1 urinal per 50 workers.

(2) Under temporary field conditions, provisions shall be made to assure not less than one toilet facility is available.

(3) Job sites, not provided with a sanitary sewer, shall be provided with one of the following toilet facilities unless prohibited by local codes:

(i) Privies (where their use will not contaminate ground or surface water);

(ii) Chemical toilets;

(iii) Recirculating toilets;

(iv) Combustion toilets.

(4) The requirements of this paragraph (c) for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(d) Food handling.

(1) All employees' food service facilities and operations shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(2) All employee food service facilities and operations shall be carried out in accordance with sound hygienic principles. In all places of employment where all or part of the food service is provided, the food dispensed shall be wholesome, free from spoilage, and shall be processed, prepared, handled, and stored in such a manner as to be protected against contamination.

(e) Temporary sleeping quarters. When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(f) Washing facilities.

(1) The employer shall provide adequate washing facilities for employees engaged in the application of paints, coating, herbicides, or insecticides, or in other operations where contaminants may be harmful to the employees. Such facilities shall be in near proximity to the worksite and shall be so equipped as to enable employees to remove such substances.

(2) General. Washing facilities shall be maintained in a sanitary condition.

(3) Lavatories.

(i) Lavatories shall be made available in all places of employment. The requirements of this subdivision do not apply to mobile crews or to normally unattended work locations if employees working at these locations have transportation readily available to nearby washing facilities which meet the other requirements of this paragraph.

(ii) Each lavatory shall be provided with hot and cold running water, or tepid running water.

(iii) Hand soap or similar cleansing agents shall be provided.

(iv) Individual hand towels or sections thereof, of cloth or paper, warm air blowers or clean individual sections of continuous cloth toweling, convenient to the lavatories, shall be provided.

(4) Showers.

(i) Whenever showers are required by a particular standard, the showers shall be provided in accordance with paragraphs (f)(4) (ii) through (v) of this section.

(ii) One shower shall be provided for each 10 employees of each sex, or numerical fraction thereof, who are required to shower during the same shift.

(iii) Body soap or other appropriate cleansing agents convenient to the showers shall be provided as specified in paragraph (f)(3)(iii) of this section.

(iv) Showers shall be provided with hot and cold water feeding a common discharge line.

(v) Employees who use showers shall be provided with individual clean towels.

(g) Eating and drinking areas. No employee shall be allowed to consume food or beverages in a toilet room nor in any area exposed to a toxic material.

(h) Vermin control. Every enclosed workplace shall be so constructed, equipped, and maintained, so far as reasonably practicable, as to prevent the entrance or harborage of rodents, insects, and other vermin. A continuing and effective extermination program shall be instituted where their presence is detected.

(i) Change rooms. Whenever employees are required by a particular standard to wear protective clothing because of the possibility of contamination with toxic materials, change rooms equipped with storage facilities for street clothes and separate storage facilities for the protective clothing shall be provided.

29 CFR 1926.52
OCCUPATIONAL NOISE EXPOSURE

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table D-2 of this section when measured on the A-scale of a standard sound level meter at slow response.

(b) When employees are subjected to sound levels exceeding those listed in Table D-2 of this section, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within the levels of the table, personal protective equipment as required in Subpart E, shall be provided and used to reduce sound levels within the levels of the table.
(c) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous.

(d)(1) In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered.

TABLE D-2
PERMISSIBLE NOISE EXPOSURES

Duration per day, hours	Sound level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

(2) (i) When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. Exposure to different levels for various periods of time shall be computed according to the formula set forth in paragraph (d)(2)(ii) of this section.

(ii) F(e)=(T(1)divided by L(1))+(T(2)divided by L(2))+ ... + (T(n) divided by L(n))

where:

F(e)=The equivalent noise exposure factor.

T=The period of noise exposure at any essentially constant level.
L=The duration of the permissible noise exposure at the constant level (from Table D-2).

If the value of F(e) exceeds unity (1) the exposure exceeds permissible levels.

(iii) A sample computation showing an application of the formula in paragraph (d)(2)(ii) of this section is as follows. An employee is exposed at these levels for these periods:

110 db A 1/4 hour.

100 db A 1/2 hour.

90 db A 1 1/2 hours.

F(e)=(1/4 divided by 1/2)+(1/2 divided by 2)+(1 1/2 divided by 8)

F(e)=0.500+0.25+0.188

F(e)=0.938

Since the value of F(e) does not exceed unity, the exposure is within permissible limits.

(e) Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

29 CFR 1926.53
IONIZING RADIATION

(a) In construction and related activities involving the use of sources of ionizing radiation, the pertinent provisions of the Atomic Energy Commission's Standards for Protection Against Radiation (10 CFR Part 20), relating to protection against occupational radiation exposure, shall apply.

(b) Any activity which involves the use of radioactive materials or X-rays, whether or not under license from the Atomic Energy Commission, shall be performed by competent persons specially trained in the proper and safe operation of such equipment. In the case of materials used under Commission license, only persons actually licensed, or competent persons under direction and supervision of the licensee, shall perform such work.

(c) - (r) Reserved (FR 06/20/96).

Note: The requirements applicable to construction work under paragraphs (c) through (r) are identical to those set forth at paragraphs (a) through (p) of 1910.1096 of this chapter.

29 CFR 1926.54
NONIONIZING RADIATION

(a) Only qualified and trained employees shall be ssigned to install, adjust, and operate laser equipment.

(b) Proof of qualification of the laser equipment operator shall be available and in possession of the operator at all times.

(c) Employees, when working in areas in which a potential exposure to direct or reflected laser light greater than 0.005 watts (5 milliwatts) exists, shall be provided with antilaser eye protection devices as specified in Subpart E of this part.

(d) Areas in which lasers are used shall be posted with standard laser warning placards.

(e) Beam shutters or caps shall be utilized, or the laser turned off, when laser transmission is not actually required. When the laser is left unattended for a substantial period of time, such as during lunch hour, overnight, or at change of shifts, the laser shall be turned off.

(f) Only mechanical or electronic means shall be used as a detector for guiding the internal alignment of the laser.

(g) The laser beam shall not be directed at employees.

(h) When it is raining or snowing, or when there is dust or fog in the air, the operation of laser systems shall be prohibited where practicable; in any event, employees shall be kept out of range of the area of source and target during such weather conditions.

(i) Laser equipment shall bear a label to indicate maximum output.

(j) Employees shall not be exposed to light intensities above:

(1) Direct staring: 1 micro-watt per square centimeter;

(2) Incidental observing: 1 milliwatt per square centimeter;

(3) Diffused reflected light: 2 1/2 watts per square centimeter.

(k) Laser unit in operation should be set up above the heads of the employees, when possible.

(l) Employees shall not be exposed to microwave power densities in excess of 10 milliwatts per square centimeter.

29 CFR 1926.55
GASES, VAPORS, FUMES, DUSTS, & MISTS

(a) Exposure of employees to inhalation, ingestion, skin absorption, or contact with any material or substance at a concentration above those specified in the "Threshold Limit Values of Airborne Contaminants for 1970" of the American Conference of Governmental Industrial Hygienists, shall be avoided. See Appendix A to this section.

(b) To achieve compliance with paragraph (a) of this section, administrative or engineering controls must first be implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and technical measures used for this purpose must first be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with 1926.103.

(c) Paragraphs (a) and (b) of this section do not apply to the exposure of employees to airborne asbestos dust. Whenever any employee is exposed to airborne asbestos, tremolite, anthophyllite, or actinolite dust, the requirements of 1910.1101 or 1926.58 of this title shall apply.

(d) Paragraphs (a) and (b) of this section do not apply to the exposure of employees to formaldehyde. Whenever any employee is exposed to formaldehyde, the requirements of 1910.1048 of this title shall apply.

Appendix A
1970 American Conference of Governmental Industrial Hygienists' Threshold Limit Values of Airborne Contaminants

Acetaldehyde	**CAS NO(c): 75-07-0**		
PEL(1)		**200 ppm(a)**	**360 mg/m(3)(b)**
Skin Designation		**-**	
Acetic acid	**CAS NO(c): 64-19-7**		
PEL(1)		**10 ppm(a)**	**25 mg/m(3)(b)**
Skin Designation		**-**	
Acetic anhydride	**CAS NO(c): 108-24-7**		
PEL(1)		**5 ppm(a)**	**20 mg/m(3)(b)**
Skin Designation		**-**	
Acetone(h)	**CAS NO(c): 67-64-1**		
PEL(1)		**1000 ppm(a)**	**2400 mg/m(3)(b)**
Skin Designation		**-**	
Acetonitrile	**CAS NO(c): 75-05-8**		
PEL(1)		**40 ppm(a)**	**70 mg/m(3)(b)**
Skin Designation		**-**	
2-Acetylaminofluorine; see 1910.1014	**CAS NO(c): 53-96-3**		
Acetylene dichloride; see 1,1-Dichloroethylene			
Acetylene tetrabromide	**CAS NO(c): 79-27-6**		
PEL(1)		**1 ppm(a)**	**14 mg/m(3)(b)**

Skin Designation	-		
Acetylsalicylic acid (Aspirin)	**CAS NO(c): 50-78-2**		
PEL(1)	-	-	
Skin Designation	-		
Acrolein	**CAS NO(c): 107-02-8**		
PEL(1)	0.1 ppm(a)	0.25 mg/m(3)(b)	
Skin Designation	-		
Acrylamide	**CAS NO(c): 79-06-1**		
PEL(1)	-	0.3 mg/m(3)(b)	
Skin Designation	X		
Acrylic acid	**CAS NO(c): 79-10-7**		
PEL(1)	-	-	
Skin Designation	-		
Acrylonitrile; see 1910.1045	**CAS NO(c): 107-13-1**		
Aldrin	**CAS NO(c): 309-00-2**		
PEL(1)	-	0.25 mg/m(3)(b)	
Skin Designation	X		
Allyl alcohol	**CAS NO(c): 107-18-6**		
PEL(1)	2 ppm(a)	5 mg/m(3)(b)	
Skin Designation	X		
Allyl chloride	**CAS NO(c): 107-05-1**		
PEL(1)	1 ppm(a)	3 mg/m(3)(b)	
Skin Designation	-		
Allyl glycidyl ether (AGE)	**CAS NO(c): 106-92-3**		
PEL(1)	(C)10 ppm(a)	(C)45 mg/m(3)(b)	
Skin Designation	-		
Allyl propyl disulfide	**CAS NO(c): 2179-59-1**		
PEL(1)	2 ppm(a)	12 mg/m(3)(b)	
Skin Designation	-		
alpha-Alumina	**CAS NO(c): 1344-28-1**		
Total dust			
PEL(1)	-		
Skin Designation	-		
Respirable fraction			
PEL(1)	-		
Skin Designation	-		
4-Aminodiphenyl; see 1910.1011	**CAS NO(c): 92-67-1**		
2-Aminoethanol; see Ethanolamine			
2-Aminopyridine	**CAS NO(c): 504-29-0**		
PEL(1)	0.5 ppm(a)	2 mg/m(3)(b)	
Skin Designation	-		

Amitrole	**CAS NO(c): 61-82-5**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Ammonia	**CAS NO(c): 7664-41-7**		
PEL(1)	**50 ppm(a)**	**35 mg/m(3)(b)**	
Skin Designation	**-**		
Ammonium chloride fume	**CAS NO(c): 12125-02-9**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Ammonium sulfamate	**CAS NO(c): 7773-06-0**		
Total dust			
PEL(1)	**-**	**15 mg/m(3)(b)**	
Skin Designation	**-**		
Respirable fraction			
PEL(1)	**-**	**5 mg/m(3)(b)**	
Skin Designation	**-**		
n-Amyl acetate	**CAS NO(c): 628-63-7**		
PEL(1)	**100 ppm(a)**	**525 mg/m(3)(b)**	
Skin Designation	**-**		
sec-Amyl acetate	**CAS NO(c): 626-38-0**		
PEL(1)	**125 ppm(a)**	**650 mg/m(3)(b)**	
Skin Designation	**-**		
Aniline and homologs	**CAS NO(c): 62-53-3**		
PEL(1)	**5 ppm(a)**	**19 mg/m(3)(b)**	
Skin Designation	**X**		
Anisidine (o-,p-isomers)	**CAS NO(c): 29191-52-4**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**	
Skin Designation	**X**		
Antimony and compounds (as Sb)	**CAS NO(c): 7440-36-0**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**	
Skin Designation	**-**		
ANTU (alpha Naphthylthiourea)	**CAS NO(c): 86-88-4**		
PEL(1)	**-**	**0.3 mg/m(3)(b)**	
Skin Designation	**-**		
Arsenic, organic compounds (as As)	**CAS NO(c): 7440-38-2**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**	
Skin Designation	**-**		
Arsenic, inorganic compounds (as As);	**CAS NO(c): Varies with compound**		
Arsine	**CAS NO(c): 7784-42-1**		
PEL(1)	**0.05 ppm(a)**	**0.2 mg/m(3)(b)**	
Skin Designation	**-**		
Asbestos; see 1910.0110 and 1910.1001	**CAS NO(c): Varies**		
Atrazine	**CAS NO(c): 1912-24-9**		
PEL(1)	**-**	**-**	

Skin Designation		-	
Azinphos-metyl	CAS NO(c): 86-50-0		
PEL(1)		-	0.2 mg/m(3)(b)
Skin Designation		X	
Barium, soluble compounds (as Ba)	CAS NO(c): 7440-39-3		
PEL(1)		-	0.5 mg/m(3)(b)
Skin Designation		-	
Benzene;(d)	CAS NO(c): 71-43-2		
See 1910.1028			
See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028(d)			
Benzidine;	CAS NO(c): 92-87-5		
See 1910.1010			
p-Benzoquinone;			
see Quinone			
Benzo(a)pyrene;			
see Coal tar pitch volatiles			
Benzoyl peroxide	CAS NO(c): 94-36-0		
PEL(1)		-	5 mg/m(3)(b)
Skin Designation		-	
Benzyl chloride	CAS NO(c): 100-44-7		
PEL(1)		1 ppm(a)	5 mg/m(3)(b)
Skin Designation		-	
Beryllium and beryllium compounds (as Be)	CAS NO(c): 7440-41-7		
PEL(1)			Tbl. Z-2
Skin Designation			
Biphenyl;			
see Diphenyl			
Bismuth telluride, Se-doped			
PEL(1)		-	-
Skin Designation		-	
Borates, tetra, sodium salts			
Anhydrous	CAS NO(c): 1330-43-4		
PEL(1)		-	-
Skin Designation		-	
Decahydrate	CAS NO(c): 1303-96-4		
PEL(1)		-	-
Skin Designation		-	
Pentahydrate	CAS NO(c): 12179-04-3		
PEL(1)		-	-
Skin Designation		-	
Boron oxide	CAS NO(c): 1303-86-2		
Total dust			
PEL(1)		-	15 mg/m(3)(b)
Skin Designation		-	

Boron tribromide	**CAS NO(c): 10294-33-4**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Boron trifluoride	**CAS NO(c): 7637-07-2**		
PEL(1)	**(C)1 ppm(a)**	**(C)3 mg/m(3)(b)**	
Skin Designation	**-**		
Bromacil	**CAS NO(c): 314-40-9**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Bromine	**CAS NO(c): 7726-95-6**		
PEL(1)	**0.1 ppm(a)**	**0.7 mg/m(3)(b)**	
Skin Designation	**-**		
Bromine pentafluoride	**CAS NO(c): 7789-30-2**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Bromoform	**CAS NO(c): 75-25-2**		
PEL(1)	**0.5 ppm(a)**	**5 mg/m(3)(b)**	
Skin Designation	**X**		
Butadiene (1,3-Butadiene)	**CAS NO(c): 106-99-0**		
PEL(1)	**1000 ppm(a)**	**2200 mg/m(3)(b)**	
Skin Designation	**-**		
Butane	**CAS NO(c): 106-97-8**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Butanethiol; see Butyl mercaptan			
2-Butanone (Methyl ethyl ketone)	**CAS NO(c): 78-93-3**		
PEL(1)	**200 ppm(a)**	**590 mg/m(3)(b)**	
Skin Designation	**-**		
2-Butoxyethanol	**CAS NO(c): 111-76-2**		
PEL(1)	**50 ppm(a)**	**240 mg/m(3)(b)**	
Skin Designation	**X**		
n-Butyl-acetate	**CAS NO(c): 123-86-4**		
PEL(1)	**150 ppm(a)**	**710 mg/m(3)(b)**	
Skin Designation	**-**		
sec-Butyl acetate	**CAS NO(c): 105-46-4**		
PEL(1)	**200 ppm(a)**	**950 mg/m(3)(b)**	
Skin Designation	**-**		
tert-Butyl-acetate	**CAS NO(c): 540-88-5**		
PEL(1)	**200 ppm(a)**	**950 mg/m(3)(b)**	
Skin Designation	**-**		
Butyl acrylate	**CAS NO(c): 141-32-2**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
n-Butyl alcohol	**CAS NO(c): 71-36-3**		

PEL(1)	100 ppm(a)	300 mg/m(3)(b)
Skin Designation	-	

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sec-Butyl alcohol	CAS NO(c): 78-92-2	
PEL(1)	150 ppm(a)	450 mg/m(3)(b)
Skin Designation	-	

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tert-Butyl alcohol	CAS NO(c): 75-65-0	
PEL(1)	100 ppm(a)	300 mg/m(3)(b)
Skin Designation	-	

Butylamine	CAS NO(c): 109-73-9	
PEL(1)	(C)5 ppm(a)	(C)15 mg/m(3)(b)
Skin Designation	X	

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tert-Butyl chromate (as CrO(3))	CAS NO(c): 1189-85-1	
PEL(1)	-	(C)0.1 mg/m(3)(b)
Skin Designation	X	

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n-Butyl glycidyl ether (BGE)	CAS NO(c): 2426-08-6	
PEL(1)	50 ppm(a)	270 mg/m(3)(b)
Skin Designation	-	

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n-Butyl lactate	CAS NO(c): 138-22-7	
PEL(1)	-	-
Skin Designation	-	

Butyl mercaptan	CAS NO(c): 109-79-5	
PEL(1)	10 ppm(a)	35 mg/m(3)(b)
Skin Designation	-	

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o-sec-Butylphenol	CAS NO(c): 89-72-5	
PEL(1)	-	-
Skin Designation	-	

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p-tert-Butyltoluene	CAS NO(c): 98-51-1	
PEL(1)	10 ppm(a)	60 mg/m(3)(b)
Skin Designation	-	

Cadmium fume (as Cd) see 1910.1027.	CAS NO(c): 7440-43-9	

Cadmium dust (as Cd) see 1910.1027.	CAS NO(c): 7440-43-9	

Calcium Carbonate	CAS NO(c): 1317-65-3	
Total dust		
PEL(1)	-	
Skin Designation	-	
Respirable fraction		
PEL(1)	-	
Skin Designation	-	

Calcium cyanamide	CAS NO(c): 156-62-7	
PEL(1)	-	-
Skin Designation	-	

Calcium oxide(j)	CAS NO(c): 1305-78-8	
PEL(1)	-	5 mg/m(3)(b)

Skin Designation	-	
Calcium sulfate	**CAS NO(c): 7778-18-9**	
Total dust		
PEL(1)	-	15 mg/m(3)(b)
Skin Designation	-	
Respirable fraction		
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	
Camphor, synthetic	**CAS NO(c): 76-22-2**	
PEL(1)	-	2 mg/m(3)(b)
Skin Designation	-	
Caprolactam	**CAS NO(c): 105-60-2**	
Dust		
PEL(1)	-	-
Skin Designation	-	
Vapor		
PEL(1)	-	-
Skin Designation	-	
Captafol (Difolatan(R))	**CAS NO(c): 2425-06-1**	
PEL(1)	-	-
Skin Designation	-	
Captan	**CAS NO(c): 133-06-2**	
PEL(1)	-	-
Skin Designation	-	
Carbaryl (Sevin(R))	**CAS NO(c): 63-25-2**	
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	
Carbofuran (Furadan (R))	**CAS NO(c): 1563-66-2**	
PEL(1)	-	-
Skin Designation	-	
Carbon black	**CAS NO(c): 1333-86-4**	
PEL(1)	-	3.5 mg/m(3)(b)
Skin Designation	-	
Carbon dioxide	**CAS NO(c): 124-38-9**	
PEL(1)	5000(e) ppm(a)	9,000 mg/m(3)(b)
Skin Designation	-	
Carbon disulfide	**CAS NO(c): 75-15-0**	
PEL(1)	Tbl. Z-2	
Carbon monoxide	**CAS NO(c): 630-08-0**	
PEL(1)	50 ppm(a)	55 mg/m(3)(b)
Skin Designation	-	
Carbon tetrabromide	**CAS NO(c): 558-13-4**	
PEL(1)	-	-
Skin Designation	-	
Carbon tetrachloride	**CAS NO(c): 56-23-5**	
PEL(1)	Tbl. Z-2	

Skin Designation	-		
Carbonyl fluoride	**CAS NO(c): 353-50-4**		
PEL(1)	-	-	
Skin Designation	-		
Catechol (Pyrocatechol)	**CAS NO(c): 120-80-9**		
PEL(1)	-	-	
Skin Designation	-		
Cellulose	**CAS NO(c): 9004-34-6**		
Total dust			
PEL(1)	-		
Skin Designation	-		
Respirable fraction			
PEL(1)	-		
Skin Designation	-		
Cesium hydroxide	**CAS NO(c): 21351-79-1**		
PEL(1)	-	-	
Skin Designation	-		
Chlordane	**CAS NO(c): 57-74-9**		
PEL(1)	-	0.5 mg/m(3)(b)	
Skin Designation	X		
Chlorinated camphene	**CAS NO(c): 8001-35-2**		
PEL(1)	-	0.5 mg/m(3)(b)	
Skin Designation	X		
Chlorinated diphenyl oxide	**CAS NO(c): 55720-99-5**		
PEL(1)	-	0.5 mg/m(3)(b)	
Skin Designation	-		
Chlorine	**CAS NO(c): 7782-50-5**		
PEL(1)	(C)1 ppm(a)	(C)3 mg/m(3)(b)	
Skin Designation	-		
Chlorine dioxide	**CAS NO(c): 10049-04-4**		
PEL(1)	0.1 ppm(a)	0.3 mg/m(3)(b)	
Skin Designation	-		
Chlorine trifluoride	**CAS NO(c): 7790-91-2**		
PEL(1)	(C)0.1 ppm(a)	(C)0.4 mg/m(3)(b)	
Skin Designation	-		
Chloroacetaldehyde	**CAS NO(c): 107-20-0**		
PEL(1)	(C)1 ppm(a)	(C)3 mg/m(3)(b)	
Skin Designation	-		
a-Chloroacetophenone (Phenacyl chloride)	**CAS NO(c): 532-27-4**		
PEL(1)	0.05 ppm(a)	0.3 mg/m(3)(b)	
Skin Designation	-		
Chloroacetyl chloride	**CAS NO(c): 79-04-9**		
PEL(1)	-	-	
Skin Designation	-		
Chlorobenzene	**CAS NO(c): 108-90-7**		

PEL(1)		75 ppm(a)	350 mg/m(3)(b)
Skin Designation		-	

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o-Chlorobenzylidene malononitrile CAS NO(c): 2698-41-1

PEL(1)		0.05 ppm(a)	0.4 mg/m(3)(b)
Skin Designation		-	

Chlorobromomethane CAS NO(c): 74-97-5

PEL(1)		200 ppm(a)	1050 mg/m(3)(b)
Skin Designation		-	

2-Chloro-1,3-butadiene;
See b-Chloroprene

Chlorodifluoromethane CAS NO(c): 75-45-6

PEL(1)		-	-
Skin Designation		-	

Chlorodiphenyl (42% Chlorine) (PCB) CAS NO(c): 53469-21-9
STD 1-4.2

PEL(1)		-	1 mg/m(3)(b)
Skin Designation		X	

Chlorodiphenyl (54% Chlorine) (PCB) CAS NO(c): 11097-69-1
STD 1-4.2

PEL(1)		-	0.5 mg/m(3)(b)
Skin Designation		X	

1-Chloro,2,3-epoxypropane;
See Epichlorohydrin

2-Chloroethanol;
See Ethylene chlorohydrin

Chloroethylene;
See Vinyl chloride

Chloroform (Trichloromethane) CAS NO(c): 67-66-3

PEL(1)		(C)50 ppm(a)	(C)240 mg/m(3)(b)
Skin Designation		-	

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bis(Chloromethyl) ether; CAS NO(c): 542-88-1
See 1910.1008

Chloromethyl methyl ether; CAS NO(c): 107-30-2
SEE 1910.1006

1-Chloro-1-nitropropane CAS NO(c): 600-25-9

PEL(1)		20 ppm(a)	100 mg/m(3)(b)
Skin Designation		-	

Chloropentafluoroethane CAS NO(c): 76-15-3

PEL(1)		-	-
Skin Designation		-	

Chloropicrin CAS NO(c): 76-06-2

PEL(1)		0.1 ppm(a)	0.7 mg/m(3)(b)
Skin Designation		-	

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beta-Chloroprene	**CAS NO(c): 126-99-8**		
PEL(1)	**25 ppm(a)**	**90 mg/m(3)(b)**	
Skin Designation	**X**		
o-Chlorostyrene	**CAS NO(c): 2039-87-4**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
o-Chlorotoluene	**CAS NO(c): 95-49-8**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Chlorpyrifos	**CAS NO(c): 2921-88-2**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Chromic acid and chromates (as CrO(3)) (4)	**CAS NO(c): 7440-47-3**		
PEL(1)		**Tbl. Z-2**	
Skin Designation	**-**		
Chromium, sol. chromic, chromous salts (as Cr)	**CAS NO(c): 7440-47-3**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**	
Skin Designation	**-**		
Chromium, metal and insoluble salts	**CAS NO(c): 7440-47-3**		
PEL(1)	**-**	**1 mg/m(3)(b)**	
Skin Designation	**-**		
Chrysene; **See Coal tar pitch volatiles**			
Coal dust (Less than 5% SiO(2)), Respirable fraction			
PEL(1)		**Tbl. Z-3**	
Skin Designation	**-**		
Coal dust (Greater than or equal to 5% SiO(2)), Respirable quartz fraction			
PEL(1)		**Tbl. Z-3**	
Skin Designation	**-**		
Coal tar pitch volatiles (Benzine soluble fraction), Anthracene, BaP, Phenanthrene, Acridine, Chrysene, Pyrene	**CAS NO(c): 65996-93-2**		
PEL(1)	**-**	**0.2 mg/m(3)(b)**	
Skin Designation	**-**		
Cobalt metal, dust, and fume (as Co)	**CAS NO(c): 7440-48-4**		
PEL(1)	**-**	**0.1 mg/m(3)(b)**	
Skin Designation	**-**		
Cobalt carbonyl (as Co)	**CAS NO(c): 10210-68-1**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Cobalt hydrocarbonyl (as Co)	**CAS NO(c): 16842-03-8**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		

Coke oven emissions; see 1910.1029			
Copper	CAS NO(c): 7440-50-8		
Fume (as Cu)			
PEL(1)	-		0.1 mg/m(3)(b)
Skin Designation	-		
Dusts and mists (as Cu)			
PEL(1)	-		1 mg/m(3)(b)
Skin Designation	-		
Cotton dust (Raw)			
PEL(1)			1 mg/m(3)(b)
Crag herbicide (Sesone)	CAS NO(c): 136-78-7		
Total dust			
PEL(1)	-		
Skin Designation	-		
Respirable fraction			
PEL(1)	-		
Skin Designation	-		
Cresol, all isomers	CAS NO(c): 1319-77-3		
PEL(1)	5 ppm(a)		22 mg/m(3)(b)
Skin Designation	X		
Crotonaldehyde	CAS NO(c): 123-73-9; 4170-30-3		
PEL(1)	2 ppm(a)		6 mg/m(3)(b)
Skin Designation	-		
Crufomate	CAS NO(c): 299-86-5		
PEL(1)	-		-
Skin Designation	-		
Cumene	CAS NO(c): 98-82-8		
PEL(1)	50 ppm(a)		245 mg/m(3)(b)
Skin Designation	X		
Cyanamide	CAS NO(c): 420-04-2		
PEL(1)	-		-
Skin Designation	-		
Cyanides (as CN) (4)	CAS NO(c): Varies With Compound		
PEL(1)	-		5 mg/m(3)(b)
Skin Designation	X		
Cyanogen	CAS NO(c): 460-19-5		
PEL(1)	-		-
Skin Designation	-		
Cyanogen chloride	CAS NO(c): 506-77-4		
PEL(1)	-		-
Skin Designation	-		
Cyclohexane	CAS NO(c): 110-82-7		
PEL(1)	300 ppm(a)		1050 mg/m(3)(b)

Skin Designation	-		
Cyclohexanol	**CAS NO(c): 108-93-0**		
PEL(1)	50 ppm(a)	200 mg/m(3)(b)	
Skin Designation	-		
1926.55 App A / Cyclohexanone			
Cyclohexanone	**CAS NO(c): 108-94-1**		
PEL(1)	50 ppm(a)	200 mg/m(3)(b)	
Skin Designation	-		
Cyclohexene	**CAS NO(c): 110-83-8**		
PEL(1)	300 ppm(a)	1015 mg/m(3)(b)	
Skin Designation	-		
Cyclohexylamine	**CAS NO(c): 108-91-8**		
PEL(1)	-	-	
Skin Designation	-		
Cyclonite	**CAS NO(c): 121-82-4**		
PEL(1)	-	-	
Skin Designation	-		
Cyclopentadiene	**CAS NO(c): 542-92-7**		
PEL(1)	75 ppm(a)	200 mg/m(3)(b)	
Skin Designation	-		
Cyclopentane	**CAS NO(c): 287-92-3**		
PEL(1)	-	-	
Skin Designation	-		
Cyhexatin	**CAS NO(c): 13121-70-5**		
PEL(1)	-	-	
Skin Designation	-		
DDT, see Dichlorodiphenyltrichloroethane			
DDVP, see Dichlorvos			
Decaborane	**CAS NO(c): 17702-41-9**		
PEL(1)	0.05 ppm(a)	0.3 mg/m(3)(b)	
Skin Designation	X		
Demeton (Systox(R))	**CAS NO(c): 8065-48-3**		
PEL(1)	-	0.1 mg/m(3)(b)	
Skin Designation	X		
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone)		**CAS NO(c): 123-42-2**	
PEL(1)	50 ppm(a)	240 mg/m(3)(b)	
Skin Designation	-		
1,2-Diaminoethane; See Ethylenediamine			
Diazinon	**CAS NO(c): 333-41-5**		
PEL(1)	-	-	
Skin Designation	-		
Diazomethane	**CAS NO(c): 334-88-3**		

PEL(1)		0.2 ppm(a)	0.4 mg/m(3)(b)
Skin Designation		-	
Diborane	**CAS NO(c): 19287-45-7**		
PEL(1)		0.1 ppm(a)	0.1 mg/m(3)(b)
Skin Designation		-	
1,2-Dibromo-3-chloropropane(DBCP); See 1910.1044	**CAS NO(c): 96-12-8**		
Skin Designation		-	
2-N-Dibutylaminoethanol	**CAS NO(c): 102-81-8**		
PEL(1)		-	-
Skin Designation		-	
Dibutyl phosphate	**CAS NO(c): 107-66-4**		
PEL(1)		1 ppm(a)	5 mg/m(3)(b)
Skin Designation		-	
Dibutyl phthalate	**CAS NO(c): 84-74-2**		
PEL(1)		-	5 mg/m(3)(b)
Skin Designation		-	
Dichloroacetylene	**CAS NO(c): 7572-29-4**		
PEL(1)		-	-
Skin Designation		-	
o-Dichlorobenzene	**CAS NO(c): 95-50-1**		
PEL(1)		(C)50 ppm(a)	(C)300 mg/m(3)(b)
Skin Designation		-	
p-DICHLOROBENZENE	**CAS NO(c): 106-46-7**		
PEL(1)		75 ppm(a)	450 mg/m(3)(b)
Skin Designation		-	
3,3'-Dichlorobenzidine; See 1910.1007	**CAS NO(c): 91-94-1**		
Dichlorodiphenyltrichloroethane (DDT)	**CAS NO(c): 50-29-3**		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		X	
2,4-D (Dichlorophenoxyacetic acid)	**CAS NO(c): 94-75-7**		
PEL(1)		-	10 mg/m(3)(b)
Skin Designation		-	
Dichlorodifluoro-methane	**CAS NO(c): 75-71-8**		
PEL(1)		1000 ppm(a)	4950 mg/m(3)(b)
Skin Designation		-	
1,3-Dichloro-5,5-dimethyl hydantoin	**CAS NO(c): 118-52-5**		
PEL(1)		-	0.2 mg/m(3)(b)
Skin Designation		-	
1,1-Dichloroethane	**CAS NO(c): 75-34-3**		
PEL(1)		100 ppm(a)	400 mg/m(3)(b)
Skin Designation		-	
1,2-Dichloroethylene	**CAS NO(c): 540-59-0**		

PEL(1)		200 ppm(a)	790 mg/m(3)(b)
Skin Designation		-	
Dichloroethyl ether	**CAS NO(c): 111-44-4**		
PEL(1)		(C)15 ppm(a)	(C)90 mg/m(3)(b)
Skin Designation		X	
Dichloromethane; See Methylene chloride			
Dichloromonofluoro-methane	**CAS NO(c): 75-43-4**		
PEL(1)		1000 ppm(a)	4200 mg/m(3)(b)
Skin Designation		-	
1,1-Dichloro-1-nitroethane	**CAS NO(c): 594-72-9**		
PEL(1)		(C)10 ppm(a)	(C)60 mg/m(3)(b)
Skin Designation		-	
1,2-Dichloropropane; See Propylenedichloride			
1,3-Dichloropropene	**CAS NO(c): 542-75-6**		
PEL(1)		-	-
Skin Designation		-	
2,2-Dichloropropionic acid	**CAS NO(c): 75-99-0**		
PEL(1)		-	-
Skin Designation		-	
Dichlorotetrafluoroethane	**CAS NO(c): 76-14-2**		
PEL(1)		1000 ppm(a)	7000 mg/m(3)(b)
Skin Designation		-	
Dichlorvos (DDVP)	**CAS NO(c): 62-73-7**		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		X	
Dicrotophos	**CAS NO(c): 141-66-2**		
PEL(1)		-	-
Skin Designation		-	
Dicyclopentadiene	**CAS NO(c): 77-73-6**		
PEL(1)		-	-
Skin Designation		-	
Dieldrin	**CAS NO(c): 60-57-1**		
PEL(1)		-	0.25 mg/m(3)(b)
Skin Designation		X	
Diethanolamine	**CAS NO(c): 111-42-2**		
PEL(1)		-	-
Skin Designation		-	
Diethylamine	**CAS NO(c): 109-89-7**		
PEL(1)		25 ppm(a)	75 mg/m(3)(b)
Skin Designation		-	
2-Diethylaminoethanol	**CAS NO(c): 100-37-8**		
PEL(1)		10 ppm(a)	50 mg/m(3)(b)

Skin Designation	X		
Diethylene triamine	**CAS NO(c): 111-40-0**		
PEL(1)	-	-	
Skin Designation	-		
Diethyl ether; See Ethyl ether			
Diethyl ketone	**CAS NO(c): 96-22-0**		
PEL(1)	-	-	
Skin Designation	-		
Diethyl phthalate	**CAS NO(c): 84-66-2**		
PEL(1)	-	-	
Skin Designation	-		
Difluorodibromomethane	**CAS NO(c): 75-61-6**		
PEL(1)	100 ppm(a)	860 mg/m(3)(b)	
Skin Designation	-		
Diglycidyl ether (DGE)	**CAS NO(c): 2238-07-5**		
PEL(1)	(C)0.5 ppm(a)	(C)2.8 mg/m(3)(b)	
Skin Designation	-		
Dihydroxybenzene; See Hydroquinone			
Diisobutyl ketone	**CAS NO(c): 108-83-8**		
PEL(1)	50 ppm(a)	290 mg/m(3)(b)	
Skin Designation	-		
Diisopropylamine	**CAS NO(c): 108-18-9**		
PEL(1)	5 ppm(a)	20 mg/m(3)(b)	
Skin Designation	X		
4-Dimethylaminoazobenzene; See 1910.1015	**CAS NO(c): 60-11-7**		
Dimethoxymethane; See Methylal			
Dimethyl acetamide	**CAS NO(c): 127-19-5**		
PEL(1)	10 ppm(a)	35 mg/m(3)(b)	
Skin Designation	-		
Dimethylamine	**CAS NO(c): 124-40-3**		
PEL(1)	10 ppm(a)	18 mg/m(3)(b)	
Skin Designation	-		
Dimethylaminobenzene; See Xylidine			
Dimethylaniline (N,N-Dimethylaniline)	**CAS NO(c): 121-69-7**		
PEL(1)	5 ppm(a)	25 mg/m(3)(b)	
Skin Designation	X		
Dimethylbenzene; See Xylene			
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	**CAS NO(c): 300-76-5**		
PEL(1)	-	3 mg/m(3)(b)	

Skin Designation	-		
Dimethylformamide	**CAS NO(c): 68-12-2**		
PEL(1)	10 ppm(a)	30 mg/m(3)(b)	
Skin Designation	X		
2,6-Dimethyl-4-hepta-none; See Diisobutyl ketone			
1,1-Dimethylhydrazine	**CAS NO(c): 57-14-7**		
PEL(1)	0.5 ppm(a)	1 mg/m(3)(b)	
Skin Designation	X		
Dimethylphthalate	**CAS NO(c): 131-11-3**		
PEL(1)	-	5 mg/m(3)(b)	
Skin Designation	-		
Dimethyl sulfate	**CAS NO(c): 77-78-1**		
PEL(1)	1 ppm(a)	5 mg/m(3)(b)	
Skin Designation	X		
Dinitolmide (3,5-Dinitro-o-toluamide)	**CAS NO(c): 148-01-6**		
PEL(1)	-	-	
Skin Designation	-		
Dinitrobenzene (all isomers)	**CAS NO(c): (alpha-)528-29-0;(meta-)99-65-0; (para-)100-25-4**		
PEL(1)	-	1 mg/m(3)(b)	
Skin Designation	X		
Dinitro-o-cresol	**CAS NO(c): 534-52-1**		
PEL(1)	-	0.2 mg/m(3)(b)	
Skin Designation	X		
Dinitrotoluene	**CAS NO(c): 25321-14-6**		
PEL(1)	-	1.5 mg/m(3)(b)	
Skin Designation	X		
Dioxane (Diethylene dioxide)	**CAS NO(c): 123-91-1**		
PEL(1)	100 ppm(a)	360 mg/m(3)(b)	
Skin Designation	X		
Dioxathion (Delnav)	**CAS NO(c): 78-34-2**		
PEL(1)	-	-	
Skin Designation	-		
Diphenyl (Biphenyl)	**CAS NO(c): 92-52-4**		
PEL(1)	0.2 ppm(a)	1 mg/m(3)(b)	
Skin Designation	-		
Diphenylamine	**CAS NO(c): 122-39-4**		
PEL(1)	-	-	
Skin Designation	-		
Diphenylmethane diisocyanate; See Methylene bisphenyl isocyanate			
Dipropylene glycol methyl ether	**CAS NO(c): 34590-94-8**		

PEL(1)		100 ppm(a)	600 mg/m(3)(b)
Skin Designation		X	
Dipropyl ketone	**CAS NO(c): 123-19-3**		
PEL(1)		-	-
Skin Designation		-	
Diquat	**CAS NO(c): 86-00-7**		
PEL(1)		-	-
Skin Designation		-	
Di-sec octyl phthalate	**(Di-2-ethylhexyl-phthalate)**	**CAS NO(c): 117-81-7**	
PEL(1)		-	5 mg/m(3)(b)
Skin Designation		-	
Disulfiram	**CAS NO(c): 97-77-8**		
PEL(1)		-	-
Skin Designation		-	
Disulfoton	**CAS NO(c): 298-04-4**		
PEL(1)		-	-
Skin Designation		-	
2,6-Di-tert-butyl-p-cresol	**CAS NO(c): 128-37-0**		
PEL(1)		-	-
Skin Designation		-	
Diuron	**CAS NO(c): 330-54-1**		
PEL(1)		-	-
Skin Designation		-	
Divinyl benzene	**CAS NO(c): 1321-74-0**		
PEL(1)		-	-
Skin Designation		-	
Emery	**CAS NO(c): 12415-34-8**		
Total dust			
PEL(1)		-	
Skin Designation		-	
Respirable fraction			
PEL(1)		-	
Skin Designation		-	
Endosulfan	**CAS NO(c): 115-29-7**		
PEL(1)		-	-
Skin Designation		-	
Endrin	**CAS NO(c): 72-20-8**		
PEL(1)		-	0.1 mg/m(3)(b)
Skin Designation		X	
Epichlorohydrin	**CAS NO(c): 106-89-8**		
PEL(1)		5 ppm(a)	19 mg/m(3)(b)
Skin Designation		X	
EPN	**CAS NO(c): 2104-64-5**		
PEL(1)		-	0.5 mg/m(3)(b)
Skin Designation		X	

1,2-Epoxypropane; See Propylene oxide

2,3-Epoxy-1-propanol; See Glycidol

Ethanethiol; See Ethyl mercaptan

Ethanolamine	CAS NO(c): 141-43-5		
PEL(1)	3 ppm(a)	6 mg/m(3)(b)	
Skin Designation	-		
Ethion	CAS NO(c): 563-12-2		
PEL(1)	-	-	
Skin Designation	-		
2-Ethoxyethanol	CAS NO(c): 110-80-5		
PEL(1)	200 ppm(a)	740 mg/m(3)(b)	
Skin Designation	X		
2-Ethoxyethyl acetate (Cellosolve acetate)	CAS NO(c): 111-15-9		
PEL(1)	100 ppm(a)	540 mg/m(3)(b)	
Skin Designation	X		
Ethyl acetate	CAS NO(c): 141-78-6		
PEL(1)	400 ppm(a)	1400 mg/m(3)(b)	
Skin Designation	-		
Ethyl acrylate	CAS NO(c): 140-88-5		
PEL(1)	25 ppm(a)	100 mg/m(3)(b)	
Skin Designation	X		
Ethyl alcohol (Ethanol)	CAS NO(c): 64-17-5		
PEL(1)	1000 ppm(a)	1900 mg/m(3)(b)	
Skin Designation	-		
Ethylamine	CAS NO(c): 75-04-7		
PEL(1)	10 ppm(a)	18 mg/m(3)(b)	
Skin Designation	-		
Ethyl amyl ketone (5-Methyl-3-heptanone)	CAS NO(c): 541-85-5		
PEL(1)	25 ppm(a)	130 mg/m(3)(b)	
Skin Designation	-		
Ethyl benzene	CAS NO(c): 100-41-4		
PEL(1)	100 ppm(a)	435 mg/m(3)(b)	
Skin Designation	-		
Ethyl bromide	CAS NO(c): 74-96-4		
PEL(1)	200 ppm(a)	890 mg/m(3)(b)	
Skin Designation	-		
Ethyl butyl ketone (3-Heptanone)	CAS NO(c): 106-35-4		
PEL(1)	50 ppm(a)	230 mg/m(3)(b)	
Skin Designation	-		
Ethyl chloride	CAS NO(c): 75-003		
PEL(1)	1000 ppm(a)	2600 mg/m(3)(b)	
Skin Designation	-		
Ethyl ether	CAS NO(c): 60-29-7		

PEL(1)		400 ppm(a)	1200 mg/m(3)(b)
Skin Designation		-	
Ethyl formate	**CAS NO(c): 109-94-4**		
PEL(1)		100 ppm(a)	300 mg/m(3)(b)
Skin Designation		-	
Ethyl mercaptan	**CAS NO(c): 75-08-1**		
PEL(1)		(C)10 ppm(a)	(C)25 mg/m(3)(b)
Skin Designation		-	
Ethyl silicate	**CAS NO(c): 78-10-4**		
PEL(1)		100 ppm(a)	850 mg/m(3)(b)
Skin Designation		-	
Ethylene chlorohydrin	**CAS: 107-07-3**		
PEL(1)		5 ppm(a)	16 mg/m(3)(b)
Skin Designation		X	
Ethylenediamine	**CAS: 107-15-3**		
PEL(1)		10 ppm(a)	25 mg/m(3)(b)
Skin Designation		-	
Ethylene dibromide	**CAS: 106-93-4**		
PEL(1)		Tbl. Z-2	Tbl. Z-2
Skin Designation		Tbl. Z-2	
Ethylene dichloride	**CAS: 107-06-2**		
PEL(1)		Tbl. Z-2	Tbl. Z-2
Skin Designation		Tbl. Z-2	
Ethylene glycol	**CAS: 107-21-1**		
PEL(1)		-	-
Skin Designation		-	
*** Ethylene glycol dinitrate(k)**	**CAS NO(c): 628-96-6**		
PEL(1)		(C)0.2 ppm(a)	(C)1 mg/m(3)(b)
Skin Designation		X	
Ethylene glycol methyl acetate; See Methyl cellosolve acetate			
Ethyleneimine; See 1910.1012	**CAS NO(c): 151-56-4**		
Ethylene oxide; See 1910.1047	**CAS NO(c): 75-21-8**		
Ethylidene chloride; See 1,1-Dichlorethane			
Ethylidene norbornene	**CAS NO(c): 16219-75-3**		
PEL(1)		-	-
Skin Designation		-	
N-Ethylmorpholine	**CAS NO(c): 100-74-3**		
PEL(1)		20 ppm(a)	94 mg/m(3)(b)
Skin Designation		X	
Fenamiphos	**CAS NO(c): 22224-92-6**		
PEL(1)		-	-
Skin Designation		-	

Fensulfothion (Dasanit)	**CAS NO(c): 115-90-2**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Fenthion	**CAS NO(c): 55-38-9**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Ferbam	**CAS NO(c): 14484-64-1**		
Total dust			
PEL(1)	**-**	**15 mg/m(3)(b)**	
Skin Designation	**-**		
Ferrovanadium dust	**CAS NO(c): 12604-58-9**		
PEL(1)	**-**	**1 mg/m(3)(b)**	
Skin Designation	**-**		
Fluorides (as F)	**CAS NO(c): Varies with Compound**		
PEL(1)		**2.5 mg/m(3)(b)**	
Skin Designation	**-**		
Fluorine	**CAS NO(c): 7782-41-4**		
PEL(1)	**0.1 ppm(a)**	**0.2 mg/m(3)(b)**	
Skin Designation	**-**		
Fluorotrichloro-methane	**(Trichloro-fluoromethane)**	**CAS NO(c): 75-69-4**	
PEL(1)	**1000 ppm(a)**	**5600 mg/m(3)(b)**	
Skin Designation	**-**		
Fononfos	**CAS NO(c): 944-22-9**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Formaldehyde; see 1910.1048.	**CAS NO(c): 50-00-0**		
Formamide	**CAS NO(c): 75-12-7**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Formic acid	**CAS NO(c): 64-18-6**		
PEL(1)	**5 ppm(a)**	**9 mg/m(3)(b)**	
Skin Designation	**-**		
Furfural	**CAS NO(c): 98-01-1**		
PEL(1)	**5 ppm(a)**	**20 mg/m(3)(b)**	
Skin Designation	**X**		
Furfuryl alcohol	**CAS NO(c): 98-00-0**		
PEL(1)	**50 ppm(a)**	**200 mg/m(3)(b)**	
Skin Designation	**-**		
Gasoline	**CAS NO(c): 8006-61-9**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Germanium tetrahydride	**CAS NO(c): 7782-65-2**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		

Glutaraldehyde	CAS NO(c): 111-30-8		
PEL(1)	-	-	
Skin Designation	-		
Glycerin (Mist)	CAS NO(c): 56-81-5		
Total dust			
PEL(1)	-		
Skin Designation	-		
Respirable fraction			
PEL(1)	-		
Skin Designation	-		
Glycidol	CAS NO(c): 556-52-5		
PEL(1)	50 ppm(a)	150 mg/m(3)(b)	
Skin Designation	-		
Glycol monoethyl ether; See 2-Ethoxyethanol			
Grain dust (oat, wheat, barley)			
PEL(1)	-	-	
Skin Designation	-		
Graphite, natural respirable dust	CAS NO(c): 7782-42-5		
PEL(1)	-	Tbl. Z-3	
Skin Designation	-		
Graphite, synthetic			
Total dust			
PEL(1)	-		
Skin Designation	-		
Respirable Fraction			
PEL(1)	-		
Skin Designation	-		
Guthion (R); See Azinphos methyl			
Gypsum	CAS NO(c): 13397-24-5		
Total dust			
PEL(1)	-		
Skin Designation	-		
Respirable fraction			
PEL(1)	-		
Skin Designation	-		
Hafnium	CAS NO(c): 7440-58-6		
PEL(1)	-	0.5 mg/m(3)(b)	
Skin Designation	-		
Heptachlor	CAS NO(c): 76-44-8		
PEL(1)	-	0.5 mg/m(3)(b)	
Skin Designation	X		
Heptane (n-Heptane)	CAS NO(c): 142-82-5		
PEL(1)	500 ppm(a)	2000 mg/m(3)(b)	
Skin Designation	-		
Hexachlorobutadiene	CAS NO(c): 87-68-3		
PEL(1)	-	-	

Skin Designation	-		
Hexachlorocyclo-pentadiene	**CAS NO(c): 77-47-4**		
PEL(1)	-	-	
Skin Designation	-		
Hexachloroethane	**CAS NO(c): 67-72-1**		
PEL(1)	1 ppm(a)	10 mg/m(3)(b)	
Skin Designation	X		
Hexachloronaphthalene	**CAS NO(c): 1335-87-1**		
PEL(1)	-	0.2 mg/m(3)(b)	
Skin Designation	X		
Hexafluoracetone	**CAS NO(c): 684-16-2**		
PEL(1)	-	-	
Skin Designation	-		
n-Hexane	**CAS NO(c): 110-54-3**		
PEL(1)	500 ppm(a)	1800 mg/m(3)(b)	
Skin Designation	-		
Hexane isomers	**CAS NO(c): Varies With Compound**		
PEL(1)	-	-	
Skin Designation	-		
2-Hexanone (Methyl n-butyl ketone)	**CAS NO(c): 591-78-6**		
PEL(1)	100 ppm(a)	410 mg/m(3)(b)	
Skin Designation	-		
Hexone (Methyl isobutyl ketone)	**CAS NO(c): 108-10-1**		
PEL(1)	100 ppm(a)	410 mg/m(3)(b)	
Skin Designation	-		
sec-Hexyl acetate	**CAS NO(c): 108-84-9**		
PEL(1)	50 ppm(a)	300 mg/m(3)(b)	
Skin Designation	-		
Hexylene glycol	**CAS NO(c): 107-41-5**		
PEL(1)	-	-	
Skin Designation	-		
Hydrazine	**CAS NO(c): 302-01-2**		
PEL(1)	1 ppm(a)	1.3 mg/m(3)(b)	
Skin Designation	X		
Hydrogenated terphenyls	**CAS NO(c): 61788-32-7**		
PEL(1)	-	-	
Skin Designation	-		
Hydrogen bromide	**CAS NO(c): 10035-10-6**		
PEL(1)	3 ppm(a)	10 mg/m(3)(b)	
Skin Designation	-		
Hydrogen chloride	**CAS NO(c): 7647-01-0**		
PEL(1)	(C)5 ppm(a)	(C)7 mg/m(3)(b)	
Skin Designation	-		
Hydrogen cyanide	**CAS NO(c): 74-90-8**		

PEL(1)	10 ppm(a)	11 mg/m(3)(b)
Skin Designation	X	
Hydrogen fluoride (as F)	**CAS NO(c): 7664-39-3**	
PEL(1)	Tbl. Z-2	
Skin Designation	-	
Hydrogen peroxide	**CAS NO(c): 7722-84-1**	
PEL(1)	1 ppm(a)	1.4 mg/m(3)(b)
Skin Designation	-	
Hydrogen selenide (as Se)	**CAS NO(c): 7783-07-5**	
PEL(1)	0.05 ppm(a)	0.2 mg/m(3)(b)
Skin Designation	-	
Hydrogen sulfide	**CAS NO(c): 7783-06-4**	
PEL(1)	Tbl. Z-2	Tbl. Z-2
Skin Designation	-	
Hydroquinone	**CAS NO(c): 123-31-9**	
PEL(1)	-	2 mg/m(3)(b)
Skin Designation	-	
2-Hydroxypropyl acrylate	**CAS NO(c): 999-61-1**	
PEL(1)	-	-
Skin Designation	-	
Indene	**CAS NO(c): 95-13-6**	
PEL(1)	-	-
Skin Designation	-	
Indium and compounds (as in)	**CAS NO(c): 7440-74-6**	
PEL(1)	-	-
Skin Designation	-	
Iodine	**CAS NO(c): 7553-56-2**	
PEL(1)	(C)0.1 ppm(a)	(C)1 mg/m(3)(b)
Skin Designation	-	
Iodoform	**CAS NO(c): 75-47-8**	
PEL(1)	-	-
Skin Designation	-	
Iron oxide dust and fume (as Fe) Total particulate	**CAS NO(c): 1309-37-1**	
PEL(1)	-	10 mg/m(3)(b)
Skin Designation	-	
Iron pentacarbonyl (as Fe)	**CAS NO(c): 13463-40-6**	
PEL(1)	-	-
Skin Designation	-	
Iron salts (Soluable) (as Fe)	**CAS NO(c): Varies With Compound**	
PEL(1)	-	-
Skin Designation	-	
Isomyl acetate	**CAS NO(c): 123-92-2**	
PEL(1)	100 ppm(a)	525 mg/m(3)(b)
Skin Designation	-	

Isomyl alcohol (primary and secondary)	**CAS NO(c): 123-51-3**		
PEL(1)	**100 ppm(a)**	**360 mg/m(3)(b)**	
Skin Designation	**-**		
Isobutyl acetate	**CAS NO(c): 110-19-0**		
PEL(1)	**150 ppm(a)**	**700 mg/m(3)(b)**	
Skin Designation	**-**		
Isobutyl alcohol	**CAS NO(c): 78-83-1**		
PEL(1)	**100 ppm(a)**	**300 mg/m(3)(b)**	
Skin Designation	**-**		
Isooctyl alcohol	**CAS NO(c): 26952-21-6**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Isophorone	**CAS NO(c): 78-59-1**		
PEL(1)	**25 ppm(a)**	**140 mg/m(3)(b)**	
Skin Designation	**-**		
Isophrone diisocyanate	**CAS NO(c): 4098-71-9**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
2-Isopropoxyethanol	**CAS NO(c): 109-59-1**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Isopropyl acetate	**CAS NO(c): 108-21-4**		
PEL(1)	**250 ppm(a)**	**950 mg/m(3)(b)**	
Skin Designation	**-**		
Isopropyl alcohol	**CAS NO(c): 67-63-0**		
PEL(1)	**400 ppm(a)**	**980 mg/m(3)(b)**	
Skin Designation	**-**		
Isopropylamine	**CAS NO(c): 75-31-0**		
PEL(1)	**5 ppm(a)**	**12 mg/m(3)(b)**	
Skin Designation	**-**		
N-Isopropylaniline	**CAS NO(c): 768-52-5**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Isopropyl ether	**CAS NO(c): 108-20-3**		
PEL(1)	**500 ppm(a)**	**2100 mg/m(3)(b)**	
Skin Designation	**-**		
Isopropyl glycidyl ether (IGE)	**CAS NO(c): 4016-14-2**		
PEL(1)	**50 ppm(a)**	**240 mg/m(3)(b)**	
Skin Designation	**-**		
Kaolin			
Total dust			
PEL(1)	**-**		
Skin Designation	**-**		
Respirable fraction			
PEL(1)	**-**		

Skin Designation	-	

Ketene	**CAS NO(c): 463-51-4**	
PEL(1)	0.5 ppm(a)	0.9 mg/m(3)(b)
Skin Designation	-	

Lead inorganic (as Pb);	**CAS NO(c): 7439-92-1**	
See 1910.1025		
see 1926.62		

Limestone	**CAS NO(c): 1317-65-3**	
Total dust		
PEL(1)	-	
Skin Designation	-	
Respirable Fraction		
PEL(1)	-	
Skin Designation	-	

Lindane	**CAS NO(c): 58-89-9**	
PEL(1)	-	0.5 mg/m(3)(b)
Skin Designation	X	

Lithium hydride	**CAS NO(c): 7580-67-8**	
PEL(1)	-	0.025 mg/m(3)(b)
Skin Designation	-	

L.P.G. (Liquified petroleum gas)	**CAS NO(c): 68476-85-7**	
PEL(1)	1000 ppm(a)	1800 mg/m(3)(b)
Skin Designation	-	

Magnesite	**CAS NO(c): 546-93-0**	
Total Dust		
PEL(1)	-	
Skin Designation	-	
Respirable Fraction		
PEL(1)	-	
Skin Designation	-	

Magnesium oxide fume	**CAS NO(c): 1309-48-4**	
Total Particulate		
PEL(1)	-15	
Skin Designation	-	

Malathion	**CAS NO(c): 121-75-5**	
TOTAL DUST:		
PEL(1)	-	15 mg/m(3)(b)
Skin Designation	X	

Maleic anhydride	**CAS NO(c): 108-31-6**	
PEL(1)	0.25 ppm(a)	1 mg/m(3)(b)

Manganese compounds (as Mn)	**CAS NO(c): 7439-96-5**	
PEL(1)	-	(C)5 mg/m(3)(b)
Skin Designation	-	

Manganese fume (as Mn)	**CAS NO(c): 7439-96-5**	
PEL(1)	-	(C)5 mg/m(3)(b)
Skin Designation	-	

Mangamese cyclopetadienyl tricarbonyl (as Mn)	**CAS NO(c): 12079-65-1**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Manganese tetroxide (as Mn)	**CAS NO(c): 1317-35-7**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Marble	**CAS NO(c): 1317-65-3**		
Total Dust			
PEL(1)	**-**		
Skin Designation	**-**		
Respirable Fraction			
PEL(1)	**-**		
Skin Designation	**-**		
Mercury (aryl and inorganic) (as Hg)	**CAS NO(c): 7439-97-6**		
PEL(1)		**Tbl. Z-2**	
Skin Designation	**-**		
Mercury (organo) alkyl compounds (as Hg)	**CAS NO(c): 7439-97-6**		
PEL(1)		**Tbl. Z-2**	
Skin Designation	**-**		
Mercury (vapor) (as Hg)	**CAS NO(c): 7439-97-6**		
PEL(1)		**Tbl. Z-2**	
Skin Designation	**-**		
Mesityl oxide	**CAS NO(c): 141-79-7**		
PEL(1)	**25 ppm(a)**	**100 mg/m(3)(b)**	
Skin Designation	**-**		
Methacrylic acid	**CAS NO(c): 79-41-4**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Methanethiol; See Methyl mercaptan			
Methomyl (Lannate)	**CAS NO(c): 16752-77-5**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Methoxychlor	**CAS NO(c): 72-43-5**		
Total dust			
PEL(1)	**-**	**15 mg/m(3)(b)**	
Skin Designation	**-**		
2-Methoxyethanol; See Methyl cellosolve			
4-Methoxyphenol	**CAS NO(c): 150-76-5**		
PEL(1)	**-**	**-**	
Skin Designation	**-**		
Methyl acetate	**CAS NO(c): 79-20-9**		
PEL(1)	**200 ppm(a)**	**610 mg/m(3)(b)**	
Skin Designation	**-**		
Methyl acetylene (Propyne)	**CAS NO(c): 74-99-7**		

PEL(1)	1000	ppm(a)	1650 mg/m(3)(b)
Skin Designation	-		

Methyl acetylene propadiene mixture (MAPP)

PEL(1)	1000	ppm(a)	1800 mg/m(3)(b)
Skin Designation	-		

Methyl acrylate CAS NO(c): 96-33-3

PEL(1)	10	ppm(a)	35 mg/m(3)(b)
Skin Designation	X		

Methylacrylonitrile CAS NO(c): 126-98-7

PEL(1)	-		-
Skin Designation	-		

Methylal (Dimethoxy-methane) CAS NO(c): 109-87-5

PEL(1)	1000	ppm(a)	3100 mg/m(3)(b)
Skin Designation	-		

Methyl alcohol CAS NO(c): 67-56-1

PEL(1)	200	ppm(a)	260 mg/m(3)(b)
Skin Designation	-		

Methylamine CAS NO(c): 74-89-5

PEL(1)	10	ppm(a)	12 mg/m(3)(b)
Skin Designation	-		

Methyl amyl alcohol; See Methyl Isobutyl carbinol

Methyl n-amyl ketone CAS NO(c): 110-43-0

PEL(1)	100	ppm(a)	465 mg/m(3)(b)
Skin Designation	-		

Methyl bromide CAS NO(c): 74-83-9

PEL(1)	(C)20	ppm(a)	(C)80 mg/m(3)(b)
Skin Designation	X		

Methyl butyl ketone; See 2-Hexanone

Methyl cellosolve (2-Methoxyethanol) CAS NO(c): 109-86-4

PEL(1)	25	ppm(a)	80 mg/m(3)(b)
Skin Designation	X		

Methyl cellosolve acetate (2-Methoxyethyl acetate) CAS NO(c): 110-49-6

PEL(1)	25	ppm(a)	120 mg/m(3)(b)
Skin Designation	X		

Methyl chloride CAS NO(c): 74-87-3

PEL(1)			Tbl. Z-2

Methyl chloroform (1,1,1-Trichloroethane) CAS NO(c): 71-55-6

PEL(1)	350	ppm(a)	1900 mg/m(3)(b)
Skin Designation	-		

Methyl 2-cyanoacrylate CAS NO(c): 137-05-3

PEL(1)	-		-
Skin Designation	-		

Methylcyclohexane CAS NO(c): 108-87-2

PEL(1)	500 ppm(a)	2000 mg/m(3)(b)
Skin Designation	-	

Methylcyclohexanol CAS NO(c): 25639-42-3

PEL(1)	100 ppm(a)	470 mg/m(3)(b)
Skin Designation	-	

o-METHYLCYCLOHEXANONE CAS NO(c): 583-60-8

PEL(1)	100 ppm(a)	460 mg/m(3)(b)
Skin Designation	X	

Methylcyclopentiadienyl manganese tricarbonyl (as Mn) CAS NO(c):12108-13-3

PEL(1)	-	-
Skin Designation	-	

Methyl demeton CAS NO(c): 8022-00-2

PEL(1)	-	-
Skin Designation	-	

4,4'-Methylene bis (2-chloroaniline)(MBOCA) CAS NO(c): 101-14-4

PEL(1)	-	-
Skin Designation	-	
Skin Designation	X	

Methylene bis (4-cyclohexylisocyanate) CAS NO(c): 5124-30-1

PEL(1)	-	-
Skin Designation	-	

Methylene chloride-see 1910.1052 -

Methyl ethyl ketone peroxide (MEKP) CAS NO(c): 1338-23-4

PEL(1)	-	-
Skin Designation	-	

Methyl formate CAS NO(c): 107-31-3

PEL(1)	100 ppm(a)	250 mg/m(3)(b)
Skin Designation	-	

Methyl hydrazine (Monomethyl hydrazine) CAS NO(c): 60-34-4

PEL(1)	(C)0.2 ppm(a)	(C)0.35 mg/m(3)(b)
Skin Designation	X	

Methyl iodide CAS NO(c): 74-88-4

PEL(1)	5 ppm(a)	28 mg/m(3)(b)
Skin Designation	X	

Methyl isoamyl ketone CAS NO(c): 110-12-3

PEL(1)	-	-
Skin Designation	-	

Methyl isobutyl carbinol CAS NO(c): 108-11-2

PEL(1)	25 ppm(a)	100 mg/m(3)(b)
Skin Designation	X	

Methyl isobutyl ketone; See Hexone

Methyl isocyanate CAS NO(c): 624-83-9

PEL(1)	0.02 ppm(a)	0.05 mg/m(3)(b)
Skin Designation	X	

Methyl isopropyl ketone	CAS NO(c): 563-80-4	
PEL(1)	-	-
Skin Designation	-	
Methyl mercaptan	CAS NO(c): 74-93-1	
PEL(1)	(C)10 ppm(a)	(C)20 mg/m(3)(b)
Skin Designation	-	
Methyl methacrylate	CAS NO(c): 80-62-6	
PEL(1)	100 ppm(a)	410 mg/m(3)(b)
Skin Designation	-	
Methyl parathion	CAS NO(c): 298-00-0	
PEL(1)	-	-
Skin Designation	-	
Methyl propyl ketone; See 2-Pentanone		
Methyl silicate	CAS NO(c): 681-84-5	
PEL(1)	(C) -	(C)-
Skin Designation	-	
alpha-Methyl styrene	CAS NO(c): 98-83-9	
PEL(1)	(C)100 ppm(a)	(c)480 mg/m(3)(b)
Skin Designation	-	
Methylene bisphenyl isocyanate (MDI)	CAS NO(c): 101-68-8	
PEL(1)	(C)0.02 ppm(a)	(C)0.2 mg/m(3)(b)
Skin Designation	-	
Methylenedianiline (MDA)	CAS NO(c): 101-77-9	
Metribuzin	CAS NO(c): 21087-64-9	
PEL(1)	-	-
Skin Designation	-	
Mica; See Silicates		
Molybdenum (as Mo)	CAS NO(c): 7439-98-7	
Soluble compounds		
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	
Insoluble Compounds - total dust		
PEL(1)	-	15 mg/m(3)(b)
Skin Designation	-	
Monocrotophos (Azodrin(R))	CAS NO(c): 6923-22-4	
PEL(1)	-	-
Skin Designation	-	
Monomethyl aniline	CAS NO(c): 100-61-8	
PEL(1)	2 ppm(a)	9 mg/m(3)(b)
Skin Designation	X	
Morpholine	CAS NO(c): 110-91-8	
PEL(1)	20 ppm(a)	70 mg/m(3)(b)
Skin Designation	X	

Naphtha (Coal tar)	CAS NO(c): 8030-30-6		
PEL(1)		100 ppm(a)	400 mg/m(3)(b)
Skin Designation		-	
Naphthalene	CAS NO(c): 91-20-3		
PEL(1)		10 ppm(a)	50 mg/m(3)(b)
Skin Designation		-	
alpha-Naphthylamine; See 1910.1004	CAS NO(c): 134-32-7		
beta-Naphthylamine; See 1910.1009	CAS NO(c): 91-59-8		
Nickel carbonyl (as Ni)	CAS NO(c): 13463-39-3		
PEL(1)		0.001 ppm(a)	0.007 mg/m(3)(b)
Skin Designation		-	
Nickel, metal and insoluble compounds (as Ni)	CAS NO(c): 7440-02-0		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		-	
Nickel, soluble compounds (as Ni)	CAS NO(c): 7440-02-0		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		-	
Nicotine	CAS NO(c): 54-11-5		
PEL(1)		-	0.5 mg/m(3)(b)
Skin Designation		X	
Nitric acid	CAS NO(c): 7697-37-2		
PEL(1)		2 ppm(a)	5 mg/m(3)(b)
Skin Designation		-	
Nitric oxide	CAS NO(c): 10102-43-9		
PEL(1)		25 ppm(a)	30 mg/m(3)(b)
Skin Designation		-	
p-Nitroaniline	CAS NO(c): 100-01-6		
PEL(1)		1 ppm(a)	6 mg/m(3)(b)
Skin Designation		X	
Nitrobenzene	CAS NO(c): 98-95-3		
PEL(1)		1 ppm(a)	5 mg/m(3)(b)
Skin Designation		X	
p-Nitrochlorobenzene	CAS NO(c): 100-00-5		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		X	
4-Nitrodiphenyl; See 1910.1003	CAS NO(c): 92-93-3		
Nitroethane	CAS NO(c): 79-24-3		
PEL(1)		100 ppm(a)	310 mg/m(3)(b)
Skin Designation		-	
Nitrogen dioxide	CAS NO(c): 10102-44-0		
PEL(1)		(C)5 ppm(a)	(C)9 mg/m(3)(b)

Skin Designation	-	
Nitrogen trifluoride	**CAS NO(c): 7783-54-1**	
PEL(1)	10 ppm(a)	29 mg/m(3)(b)
Skin Designation	-	
*** Nitroglycerin(l)**	**CAS NO(c): 55-63-0**	
PEL(1)	(C)0.2 ppm(a)	(C)2 mg/m(3)(b)
Skin Designation	X	
Nitromethane	**CAS NO(c): 75-52-5**	
PEL(1)	100 ppm(a)	250 mg/m(3)(b)
Skin Designation	-	
1-Nitropropane	**CAS NO(c): 108-03-2**	
PEL(1)	25 ppm(a)	90 mg/m(3)(b)
Skin Designation	-	
2-Nitropropane	**CAS NO(c): 79-46-9**	
PEL(1)	25 ppm(a)	90 mg/m(3)(b)
Skin Designation	-	
N-Nitrosodimethylamine; See 1910.1016	**CAS NO(c): 62-75-9**	
Nitrotoluene	**CAS NO(c): o-isomer 88-72-2; m-isomer 99-08-1; p-isomer 99-99-0**	
PEL(1)	5 ppm(a)	30 mg/m(3)(b)
Skin Designation	X	
Nitrotrichloromethane; See Chloropicrin		
Nonane	**CAS NO(c): 111-84-2**	
PEL(1)	-	-
Skin Designation	-	
Octachloronaphthalene	**CAS NO(c): 2234-13-1**	
PEL(1)	-	0.1 mg/m(3)(b)
Skin Designation	X	
Octane	**CAS NO(c): 111-65-9**	
PEL(1)	500 ppm(a)	2350 mg/m(3)(b)
Skin Designation	-	
Oil mist, mineral	**CAS NO(c): 8012-95-1**	
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	
Osmium tetroxide (as Os)	**CAS NO(c): 20816-12-0**	
PEL(1)	-	0.002 mg/m(3)(b)
Skin Designation	-	
Oxalic acid	**CAS NO(c): 144-62-7**	
PEL(1)	-	1 mg/m(3)(b)
Skin Designation	-	
Oxygen difluoride	**CAS NO(c): 7783-41-7**	
PEL(1)	0.05 ppm(a)	0.1 mg/m(3)(b)
Skin Designation	-	

Ozone	**CAS NO(c): 10028-15-6**		
PEL(1)	**0.1 ppm(a)**	**0.2 mg/m(3)(b)**
Skin Designation	**-**	
Paraffin wax fume	**CAS NO(c): 8002-74-2**		
PEL(1)	**-**	**-**
Skin Designation	**-**	
Paraquat, respirable dust	**CAS NO(c): 1910-42-5; 2074-50-2; 4685-14-7**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**
Skin Designation	**X**	
Parathion	**CAS NO(c): 56-38-2**		
PEL(1)	**-**	**0.1 mg/m(3)(b)**
Skin Designation	**X**	
Particulates not otherwise regulated			
Total Dust			
PEL(1)	**-**	**15 mg/m(3)(b)**
Skin Designation	**-**	
Respirable Fraction			
PEL(1)	**-**	**5 mg/m(3)(b)**
Skin Designation	**-**	
Pentaborane	**CAS NO(c): 19624-22-7**		
PEL(1)	**0.005 ppm(a)**	**0.01 mg/m(3)(b)**
Skin Designation	**-**	
Pentachloronaphthalene	**CAS NO(c): 1321-64-8**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**
Skin Designation	**X**	
Pentachlorophenol	**CAS NO(c): 87-86-5**		
PEL(1)	**-**	**0.5 mg/m(3)(b)**
Skin Designation	**X**	
Pentaerythritol	**CAS NO(c): 115-77-5**		
Total Dust			
PEL(1)	**-**	
Skin Designation	**-**	
Respirable Fraction			
PEL(1)	**-**	
Skin Designation	**-**	
Pentane	**CAS NO(c): 109-66-0**		
PEL(1)	**1000 ppm(a)**	**2950 mg/m(3)(b)**
Skin Designation	**-**	
2-Pentanone (Methyl propyl ketone)	**CAS NO(c): 107-87-9**		
PEL(1)	**200 ppm(a)**	**700 mg/m(3)(b)**
Skin Designation	**-**	
Perchloroethylene (Tetrachloroethylene)	**CAS NO(c): 127-18-4**		
PEL(1)	**Tbl. Z-2**	**-**
Skin Designation	**-**	
Perchloromethyl mercaptan	**CAS NO(c): 594-42-3**		

PEL(1)	0.1 ppm(a)	0.8 mg/m(3)(b)
Skin Designation	-	

Perchloryl fluoride CAS NO(c): 7616-94-6

PEL(1)	3 ppm(a)	13.5 mg/m(3)(b)
Skin Designation	-	

Petroleum distillates (Naphtha) (Rubber Solvent) CAS NO(c):8002-05-9

PEL(1)	500 ppm(a)	2000 mg/m(3)(b)
Skin Designation	-	

Phenol CAS NO(c): 108-95-2

PEL(1)	5 ppm(a)	19 mg/m(3)(b)
Skin Designation	X	

Phenothiazine CAS NO(c): 92-84-2

PEL(1)	-	-
Skin Designation	-	

p-Phenylene diamine CAS NO(c): 106-50-3

PEL(1)	-	0.1 mg/m(3)(b)
Skin Designation	X	

Phenyl ether, vapor CAS NO(c): 101-84-8

PEL(1)	1 ppm(a)	7 mg/m(3)(b)
Skin Designation	-	

Phenyl ether-biphenyl mixture, vapor

PEL(1)	1 ppm(a)	7 mg/m(3)(b)
Skin Designation	-	

Phenylethylene; See Styrene

Phenyl glycidyl ether (PGE) CAS NO(c): 122-60-1

PEL(1)	10 ppm(a)	60 mg/m(3)(b)
Skin Designation	-	

Phenylhydrazine CAS NO(c): 100-63-0

PEL(1)	5 ppm(a)	22 mg/m(3)(b)
Skin Designation	X	

Phenyl mercaptan CAS NO(c): 108-98-5

PEL(1)	-	-
Skin Designation	-	

Phenylphosphine CAS NO(c): 638-21-1

PEL(1)	-	-
Skin Designation	-	

Phorate CAS NO(c): 298-02-2

PEL(1)	-	-
Skin Designation	-	

Phosdrin (Mevinphos(R)) CAS NO(c): 7786-34-7

PEL(1)	-	0.1 mg/m(3)(b)
Skin Designation	X	

Phosgene (Carbonyl chloride) CAS NO(c): 75-44-5

PEL(1)	0.1 ppm(a)	0.4 mg/m(3)(b)

Skin Designation		-	
Phosphine	**CAS NO(c): 7803-51-2**		
PEL(1)		0.3 ppm(a)	0.4 mg/m(3)(b)
Skin Designation		-	
Phosphoric acid	**CAS NO(c): 7664-38-2**		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		-	
Phosphorus (yellow)	**CAS NO(c): 7723-14-0**		
PEL(1)		-	0.1 mg/m(3)(b)
Skin Designation		-	
Phosphorous oxychloride	**CAS NO(c): 10025-87-3**		
PEL(1)		-	-
Skin Designation		-	
Phosphorus pentachloride	**CAS NO(c): 10026-13-8**		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		-	
Phosphorus pentasulfide	**CAS NO(c): 1314-80-3**		
PEL(1)		-	1 mg/m(3)(b)
Skin Designation		-	
Phosphorus trichloride	**CAS NO(c): 7719-12-2**		
PEL(1)		0.5 ppm(a)	3 mg/m(3)(b)
Skin Designation		-	
Phthalic anhydride	**CAS NO(c): 85-44-9**		
PEL(1)		2 ppm(a)	12 mg/m(3)(b)
Skin Designation		-	
m-Phthalodinitrile	**CAS NO(c): 626-17-5**		
PEL(1)		-	-
Skin Designation		-	
Picric acid	**CAS NO(c): 88-89-1**		
PEL(1)		-	0.1 mg/m(3)(b)
Skin Designation		X	
Pindone (2-Pivalyl-1,3-indandione)	**CAS NO(c): 83-26-1**		
PEL(1)		-	0.1 mg/m(3)(b)
Skin Designation		-	
Plaster of paris	**CAS NO(c): 26499-65-0**		
Total Dust			
PEL(1)		-	
Skin Designation		-	
Respirable Fraction			
PEL(1)		-	
Skin Designation		-	
Platinum (as Pt)	**CAS NO(c): 7440-06-4**		
Metal			
PEL(1)		-	-
Skin Designation		-	
Soluble Salts			

PEL(1)	-	0.002 mg/m(3)(b)	
Skin Designation	-		
Portland cement	**CAS NO(c): 65997-15-1**		
Total Dust			
PEL(1)	-	-15	
Skin Designation	-		
Respirable Fraction			
PEL(1)	-		
Skin Designation	-		
Potassium hydroxide	**CAS NO(c): 1310-58-3**		
PEL(1)	-	-	
Skin Designation	-		
Propane	**CAS NO(c): 74-98-6**		
PEL(1)	1000 ppm(a)	1800 mg/m(3)(b)	
Skin Designation	-		
Propargyl alcohol	**CAS NO(c): 107-19-7**		
PEL(1)	-	-	
Skin Designation	-		
beta-Propriolactone; See 1910.1013	**CAS NO(c): 57-57-8**		
Propoxur (Baygon)	**CAS NO(c): 114-26-1**		
PEL(1)	-	-	
Skin Designation	-		
n-Propyl acetate	**CAS NO(c): 109-60-4**		
PEL(1)	200 ppm(a)	840 mg/m(3)(b)	
Skin Designation	-		
n-Propyl alcohol	**CAS NO(c): 71-23-8**		
PEL(1)	200 ppm(a)	500 mg/m(3)(b)	
Skin Designation	-		
n-Propyl nitrate	**CAS NO(c): 627-13-4**		
PEL(1)	25 ppm(a)	110 mg/m(3)(b)	
Skin Designation	-		
Propylene dichloride	**CAS NO(c): 78-87-5**		
PEL(1)	75 ppm(a)	350 mg/m(3)(b)	
Skin Designation	-		
Propylene glycol dinitrate	**CAS NO(c): 6423-43-4**		
PEL(1)	-	-	
Skin Designation	-		
Propylene glycol monomethyl ether	**CAS NO(c): 107-98-2**		
PEL(1)	-	-	
Skin Designation	-		
Propylene imine	**CAS NO(c): 75-55-8**		
PEL(1)	2 ppm(a)	5 mg/m(3)(b)	
Skin Designation	X		
Propylene oxide	**CAS NO(c): 75-56-9**		

PEL(1)		100 ppm(a)	240 mg/m(3)(b)
Skin Designation		-	

Propyne; See Methyl acetylene

Pyrethrum	CAS NO(c): 8003-34-7		
PEL(1)		-	5 mg/m(3)(b)
Skin Designation		-	

Pyridine	CAS NO(c): 110-86-1		
PEL(1)		5 ppm(a)	15 mg/m(3)(b)
Skin Designation		-	

Quinone	CAS NO(c): 106-51-4		
PEL(1)		0.1 ppm(a)	0.4 mg/m(3)(b)
Skin Designation		-	

Resorcinol	CAS NO(c): 108-46-3		
PEL(1)		-	-
Skin Designation		-	

Rhodium (as Rh), metal fume and insoluble compounds	CAS NO(c): 7440-16-6		
PEL(1)		-	0.1 mg/m(3)(b)
Skin Designation		-	

Rhodium (as Rh), soluble compounds	CAS NO(c): 7440-16-6		
PEL(1)		-	0.001 mg/m(3)(b)
Skin Designation		-	

Ronnel	CAS NO(c): 299-84-3		
PEL(1)		-	15 mg/m(3)(b)
Skin Designation		-	

Rosin core solder pyrolysis products, as formaldehyde			
PEL(1)		-	-
Skin Designation		-	

Rotenone	CAS NO(c): 83-79-4		
PEL(1)		-	5 mg/m(3)(b)
Skin Designation		-	

Rouge			
Total Dust			
PEL(1)			
Skin Designation		-	
Respirable Fraction			
PEL(1)			
Skin Designation		-	

Selenium compounds (as Se)	CAS NO(c): 7782-49-2		
PEL(1)		-	0.2 mg/m(3)(b)
Skin Designation		-	

Selenium hexafluoride (as Se)	CAS NO(c): 7783-79-1		
PEL(1)		0.05 ppm(a)	0.4 mg/m(3)(b)
Skin Designation		-	

Silica, amorphous, precipitated and gel			
PEL(1)		-	Tbl. Z-3

Skin Designation	-	
Silica, amorpous, diatomaceous earth, containing less than 1% crystalline silica	**CAS NO(c): 61790-53-2**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Silica, crystalline cristobalite, respirable dust	**CAS NO(c): 14464-46-1**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Silica, crystalline quartz, respirable dust	**CAS NO(c):14808-60-7**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Silica, crystalline tripoli (as quartz), respirable dust	**CAS NO(c): 1317-95-9**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Silica, crystalline tridymite, respirable dust	**CAS NO(c): 15468-32-3**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Silica, fused, respirable dust	**CAS NO(c): 60676-86-0**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Silicates (less than 1% crystalline silica)		
Mica (respirable dust)	**CAS NO(c): 12001-26-2**	
PEL(1)	-	Tbl. Z-3
Skin Designation	-	
Soapstone, Total Dust		
PEL(1)		Tbl. Z-3
Skin Designation	-	
Soapstone, Respirable Dust		
PEL(1)		Tbl. Z-3
Skin Designation	-	
Talc (containing asbestos): use asbestos limit:		
See 29 CFR 1910.100		
see 1926.58		
PEL(1)		
Skin Designation		
Tremolite, abestiform; see 1926.58		
See 29 CFR 1010.1101		
PEL(1)		
Skin Designation		
Silicon	**CAS NO(c): 7440-21-3**	
Total Dust		
PEL(1)	-	15 mg/m(3)(b)
Skin Designation	-	
Respirable Fraction		
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	

Silicon carbide	**CAS NO(c): 409-21-2**	
Total Dust		
PEL(1)	**-**	
Skin Designation	**-**	
Respirable Fraction		
PEL(1)	**-**	
Skin Designation	**-**	
Silicon tetrahydride	**CAS NO(c): 7803-62-5**	
PEL(1)	**-**	**-**
Skin Designation	**-**	
Silver, metal and soluble compounds (as Ag)	**CAS NO(c): 7440-22-4**	
PEL(1)	**-**	**0.01 mg/m(3)(b)**
Skin Designation	**-**	
Soapstone; See Silicates		
Sodium azide	**CAS NO(c): 26628-22-8**	
(as HN(3)):		
PEL(1)	**-**	**-**
Skin Designation	**-**	
(as NaN(3)):		
PEL(1)	**-**	**-**
Skin Designation	**-**	
Sodium bisulfite	**CAS NO(c): 7631-90-5**	
PEL(1)	**-**	**-**
Skin Designation	**-**	
Sodium fluoroacetate	**CAS NO(c): 62-74-8**	
PEL(1)	**-**	**0.05 mg/m(3)(b)**
Skin Designation	**X**	
Sodium hydroxide	**CAS NO(c): 1310-73-2**	
PEL(1)	**-**	**2 mg/m(3)(b)**
Skin Designation	**-**	
Sodium metabisulfite	**CAS NO(c): 7681-57-4**	
PEL(1)	**-**	**-**
Skin Designation	**-**	
Starch	**CAS NO(c): 9005-25-8**	
Total Dust		
PEL(1)	**-**	
Skin Designation	**-**	
Respirable Fraction		
PEL(1)	**-**	
Skin Designation	**-**	
Stibine	**CAS NO(c): 7803-52-3**	
PEL(1)	**0.1 ppm(a)**	**0.5 mg/m(3)(b)**
Skin Designation	**-**	
Stoddard solvent	**CAS NO(c): 8052-41-3**	
PEL(1)	**500 ppm(a)**	**2900 mg/m(3)(b)**
Skin Designation	**-**	

Strychnine	**CAS NO(c): 57-24-9**		
PEL(1)	**-**		**0.15 mg/m(3)(b)**
Skin Designation	**-**		
Styrene	**CAS NO(c): 100-42-5**		
PEL(1)	**(C) Tbl. Z-2**		**(C)-**
Skin Designation	**-**		
Subtilisins (Proteolytic enzymes)	**CAS NO(c): 9014-01-1**		
PEL(1)	**-**		**-**
Skin Designation	**-**		
Sucrose	**CAS NO(c): 57-50-1**		
Total Dust			
PEL(1)	**-**		
Skin Designation	**-**		
Respirable Fraction			
PEL(1)	**-**		
Skin Designation	**-**		
Sulfur dioxide	**CAS NO(c): 7446-09-5**		
PEL(1)	**5 ppm(a)**		**13 mg/m(3)(b)**
Skin Designation	**-**		
Sulfur hexafluoride	**CAS NO(c): 2551-62-4**		
PEL(1)	**1000 ppm(a)**		**6000 mg/m(3)(b)**
Skin Designation	**-**		
Sulfuric acid	**CAS NO(c): 7664-93-9**		
PEL(1)	**-**		**1 mg/m(3)(b)**
Skin Designation	**-**		
Sulfur monochloride	**CAS NO(c): 10025-67-9**		
PEL(1)	**1 ppm(a)**		**6 mg/m(3)(b)**
Skin Designation	**-**		
Sulfur pentafluoride	**CAS NO(c): 5714-22-7**		
PEL(1)	**0.025 ppm(a)**		**0.25 mg/m(3)(b)**
Skin Designation	**-**		
Sulfur tetrafluoride	**CAS NO(c): 7783-60-0**		
PEL(1)	**-**		**-**
Skin Designation	**-**		
Sulfuryl fluoride	**CAS NO(c): 2699-79-8**		
PEL(1)	**5 ppm(a)**		**20 mg/m(3)(b)**
Skin Designation	**-**		
Sulprofos	**CAS NO(c): 35400-43-2**		
PEL(1)	**-**		**-**
Skin Designation	**-**		
Systox (R); See Demeton			
2,4,5-T	**CAS NO(c): 93-76-5**		
PEL(1)	**-**		**10 mg/m(3)(b)**
Skin Designation	**-**		
Talc; See Silicates			

Tantalum, metal and oxide dust	**CAS NO(c): 7440-25-7**		
PEL(1)	**-**		**5 mg/m(3)(b)**
Skin Designation	**-**		
TEDP (Sulfotep)	**CAS NO(c): 3689-24-5**		
PEL(1)	**-**		**0.2 mg/m(3)(b)**
Skin Designation	**X**		
Tellurium and compounds (as Te)	**CAS NO(c): 13494-80-9**		
PEL(1)	**-**		**0.1 mg/m(3)(b)**
Skin Designation	**-**		
Tellurium hexafluoride (as Te)	**CAS NO(c): 7783-80-4**		
PEL(1)	**0.02 ppm(a)**		**0.2 mg/m(3)(b)**
Skin Designation	**-**		
Temephos	**CAS NO(c): 3383-96-8**		
Total Dust			
PEL(1)	**-**		
Skin Designation	**-**		
Respirable Fraction			
PEL(1)	**-**		
Skin Designation	**-**		
TEPP	**CAS NO(c): 107-49-3**		
PEL(1)	**-**		**0.05 mg/m(3)(b)**
Skin Designation	**X**		
Terphenylis	**CAS NO(c): 26140-60-3**		
PEL(1)	**(C)1 ppm(a)**		**(C)9 mg/m(3)(b)**
Skin Designation	**-**		
1,1,1,2-Tetrachloro-2,2-difluoroethane	**CAS NO(c): 76-11-9**		
PEL(1)	**500 ppm(a)**		**4170 mg/m(3)(b)**
Skin Designation	**-**		
1,1,2,2-Tetrachloro-1,2-difluoroethane	**CAS NO(c): 76-12-0**		
PEL(1)	**500 ppm(a)**		**4170 mg/m(3)(b)**
Skin Designation	**-**		
1,1,2,2-Tetrachloroethane	**CAS NO(c): 79-34-5**		
PEL(1)	**5 ppm(a)**		**35 mg/m(3)(b)**
Skin Designation	**X**		
Tetrachoroethylene; See Perchloroethylene			
Tetrachloromethane; See Carbon tetrachloride			
Tetrachloronaphthalene	**CAS NO(c): 1335-88-2**		
PEL(1)	**-**		**2 mg/m(3)(b)**
Skin Designation	**X**		
Tetraethyl lead (as Pb)	**CAS NO(c): 78-00-2**		
PEL(1)	**-**		**0.075 mg/m(3)(b)**
Skin Designation	**X**		
Tetrahydrofuran	**CAS NO(c): 109-99-9**		
PEL(1)	**200 ppm(a)**		**590 mg/m(3)(b)**

Skin Designation	-	
Tetramethyl lead, (as Pb)	**CAS NO(c): 75-74-1**	
PEL(1)	-	0.075 mg/m(3)(b)
Skin Designation	X	
Tetramethyl succinonitrile	**CAS NO(c): 3333-52-6**	
PEL(1)	0.5 ppm(a)	3 mg/m(3)(b)
Skin Designation	X	
Tetranitromethane	**CAS NO(c): 509-14-8**	
PEL(1)	1 ppm(a)	8 mg/m(3)(b)
Skin Designation	-	
Tetrasodium pyrophosphate	**CAS NO(c): 7722-88-5**	
PEL(1)	-	-
Skin Designation	-	
Tetryl (2,4,6-Trinitro-phenyl-methyl-nitramine)	**CAS NO(c): 479-45-8**	
PEL(1)	-	1.5 mg/m(3)(b)
Skin Designation	X	
Thallium, soluble compounds (as Ti)	**CAS NO(c): 7440-28-0**	
PEL(1)	-	0.1 mg/m(3)(b)
Skin Designation	X	
Thioglycolic acid	**CAS NO(c): 68-11-1**	
PEL(1)	-	-
Skin Designation	-	
Thionyl chloride	**CAS NO(c): 7719-09-7**	
PEL(1)	-	-
Skin Designation	-	
Thiram	**CAS NO(c): 137-26-8**	
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	
Tin, inorganic compounds (except oxides) (as Sn)	**CAS NO(c): 7440-31-5**	
PEL(1)	-	2 mg/m(3)(b)
Skin Designation	-	
Tin, organic compounds (as Sn)	**CAS NO(c): 7440-31-5**	
PEL(1)	-	0.1 mg/m(3)(b)
Skin Designation	-	
Tin oxide (as Sn)	**CAS NO(c): 21651-19-4**	
PEL(1)	-	
Skin Designation	-	
Titanium dioxide	**CAS NO(c): 13463-67-7**	
Total Dust		
PEL(1)	-	
Skin Designation	-	
Toluene	**CAS NO(c): 108-88-3**	
PEL(1)	Tbl. Z-2	-
Skin Designation	-	

Toluene-2,4-diisocyanate (TDI)	**CAS NO(c): 584-84-9**		
PEL(1)		**(C)0.02 ppm(a)**	**(C)0.14 mg/m(3)(b)**
Skin Designation		**-**	
m-Toluidine	**CAS NO(c): 108-44-1**		
PEL(1)		**-**	**-**
Skin Designation		**-**	
o-Toluidine	**CAS NO(c): 95-53-4**		
PEL(1)		**5 ppm(a)**	**22 mg/m(3)(b)**
Skin Designation		**X**	
p-Toluidine	**CAS NO(c): 106-49-0**		
PEL(1)		**-**	**-**
Skin Designation		**-**	
Toxaphene; See Chlorinated camphene			
Tremolite; See Silicates			
Tributyl phosphate	**CAS NO(c): 126-73-8**		
PEL(1)		**-**	**5 mg/m(3)(b)**
Skin Designation		**-**	
Trichloroacetic acid	**CAS NO(c): 76-03-9**		
PEL(1)		**-**	**-**
Skin Designation		**-**	
1,2,4-Trichlorobenzene	**CAS NO(c): 120-82-1**		
PEL(1)		**-**	**-**
Skin Designation		**-**	
1,1,1-Trichloroethane; See Methyl chloroform			
1,1,2-Trichloroethane	**CAS NO(c): 79-00-5**		
PEL(1)		**10 ppm(a)**	**45 mg/m(3)(b)**
Skin Designation		**X**	
Trichloroethylene	**CAS NO(c): 79-01-6**		
PEL(1)		**Tbl. Z-2**	**Tbl. Z-2**
Skin Designation		**Tbl. Z-2**	
Trichloromethane; See Chloroform			
Trichloronaphthalene	**CAS NO(c): 1321-65-9**		
PEL(1)		**-**	**5 mg/m(3)(b)**
Skin Designation		**X**	

1,2,3-Trichloropropane	CAS NO(c): 96-18-4		
PEL(1)	50 ppm(a)	300 mg/m(3)(b)	
Skin Designation	-		
1,1,2-Trichloro-1,2,2-trifluoroethane	CAS NO(c): 76-13-1		
PEL(1)	1000 ppm(a)	7600 mg/m(3)(b)	
Skin Designation	-		
Triethylamine	CAS NO(c): 121-44-8		
PEL(1)	25 ppm(a)	100 mg/m(3)(b)	
Skin Designation	-		
Trifluorobromomethane	CAS NO(c): 75-63-8		
PEL(1)	1000 ppm(a)	6100 mg/m(3)(b)	
Skin Designation	-		
Trimellitic anhydride	CAS NO(c): 552-30-7		
PEL(1)	-	-	
Skin Designation	-		
Trimethylamine	CAS NO(c): 75-50-3		
PEL(1)	-	-	
Skin Designation	-		
Trimethyl benzene	CAS NO(c): 25551-13-7		
PEL(1)	-	-	
Skin Designation	-		
Trimethyl phosphite	CAS NO(c): 121-45-9		
PEL(1)	-	-	
Skin Designation	-		
2,4,6-Trinitrophenol; See Picric acid			
2,4,6-Trinitrophenylmethyl nitramine; See Tetryl			
2,4,6-Trinitrotoluene (TNT)	CAS NO(c): 118-96-7		
PEL(1)	-	1.5 mg/m(3)(b)	
Skin Designation	X		
Triorthocresyl phosphate	CAS NO(c): 78-30-8		
PEL(1)	-	0.1 mg/m(3)(b)	
Skin Designation	-		
Triphenyl amine	CAS NO(c): 603-34-9		
PEL(1)	-	-	
Skin Designation	-		
Triphenyl phosphate	CAS NO(c): 115-86-6		
PEL(1)	-	3 mg/m(3)(b)	
Skin Designation	-		
Tungsten (as W)	CAS NO(c): 7440-33-7		
Insoluble Compounds			
PEL(1)	-	-	
Skin Designation	-		
Soluble Compounds			
PEL(1)	-	-	

Skin Designation	-	
Turpentine	**CAS NO(c): 8006-64-2**	
PEL(1)	100 ppm(a)	560 mg/m(3)(b)
Skin Designation	-	
Uranium (as U)	**CAS NO(c): 7440-61-1**	
Soluble Compounds		
PEL(1)	-	0.05 mg/m(3)(b)
Skin Designation	-	
Insoluble Compounds		
PEL(1)	-	0.25 mg/m(3)(b)
Skin Designation	-	
n-Valeraldehyde	**CAS NO(c): 110-62-3**	
PEL(1)	-	-
Skin Designation	-	
Vanadium	**CAS NO(c): 1314-62-1**	
Respirable dust (as V(2)O(5))		
PEL(1)	-	(C)0.5 mg/m(3)(b)
Skin Designation	-	
Fume (as V(2)O(5))		
PEL(1)	-	(C)0.1 mg/m(3)(b)
Skin Designation	-	
Vegetable oil mist		
Total Dust		
PEL(1)	-	
Skin Designation	-	
Respirable Fraction		
PEL(1)	-	
Skin Designation	-	
Vinyl acetate	**CAS NO(c): 108-05-4**	
PEL(1)	-	-
Skin Designation	-	
Vinyl benzene; See Styrene		
Vinyl bromide	**CAS NO(c): 593-60-2**	
PEL(1)	-	-
Skin Designation	-	
Vinyl chloride; See 1910.1017	**CAS NO(c): 75-01-4**	
Vinyl cyanide; See Acrylonitrile		
Vinyl cyclohexene dioxide	**CAS NO(c): 106-87-6**	
PEL(1)	-	-
Skin Designation	-	
Vinylidene chloride (1,1-Dichloroethylene)	**CAS NO(c): 75-35-4**	

PEL(1)	-	-	
Skin Designation	-		
Vinyl toluene	**CAS NO(c): 25013-15-4**		
PEL(1)	100 ppm(a)	480 mg/m(3)(b)	
Skin Designation	-		
VM & P Naphtha	**CAS NO(c): 8032-32-4**		
PEL(1)	-	-	
Skin Designation	-		
Warfarin	**CAS NO(c): 81-81-2**		
PEL(1)	-	0.1 mg/m(3)(b)	
Skin Designation	-		
Welding fumes (total particulate)(As determined from breathing-zone air samples)			
PEL(1)	-	-	
Skin Designation	-		
Wood dust, all soft and hard woods, except Western red cedar			
PEL(1)	-	-	
Skin Designation	-		
Wood dust, Western red cedar			
PEL(1)	-	-	
Skin Designation	-		
Xylenes (o-, m-, p- isomers)	**CAS NO(c): 1330-20-7**		
PEL(1)	100 ppm(a)	435 mg/m(3)(b)	
Skin Designation	-		
m-Xylene alpha, alpha'-diamine	**CAS NO(c): 1477-55-0**		
PEL(1)	-	-	
Skin Designation	-		
Xylidine	**CAS NO(c): 1300-73-8**		
PEL(1)	5 ppm(a)	25 mg/m(3)(b)	
Skin Designation	X		
Yttrium	**CAS NO(c): 7440-65-5**		
PEL(1)	-	1 mg/m(3)(b)	
Skin Designation	-		
Zinc chloride fume	**CAS NO(c): 7646-85-7**		
PEL(1)	-	1 mg/m(3)(b)	
Skin Designation	-		
Zinc chromate (as CrO(3))	**CAS NO(c): Varies with Compound**		
PEL(1)	Tbl. Z-2	Tbl. Z-2	
Skin Designation	Tbl. Z-2		
Zinc oxide fume	**CAS NO(c): 1314-13-2**		
PEL(1)	-	5 mg/m(3)(b)	
Skin Designation	-		
Zinc oxide Total Dust	**CAS NO(c): 1314-13-2**		

PEL(1)	-	15 mg/m(3)(b)
Skin Designation	-	
Respirable Fraction		
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	
Zirconium compounds (as Zr)	**CAS NO(c): 7440-67-7**	
PEL(1)	-	5 mg/m(3)(b)
Skin Designation	-	

Mineral dusts

Substance	mppcf (j)
SILICA:	
Crystalline	
Quartz. Threshold Limit	250 (k)
calculated from the formula	
	%SiO2+5
Cristobalite	
Amorphous, including natural	20
diatomaceous earth	
SILICATES (less than 1%	
crystalline silica)	
Mica	20
Portland cement	50
Soapstone	20
Talc (non-asbestiform)	20
Talc (fibrous), use asbestos	--
limit	
Graphite (natural)	15
Inert or Nuisance Particulates: (m)	50 (or 15 mg/m3 whichever is the smaller) of total dust <1% SiO2

[* Inert or Nuisance Dusts includes all mineral, inorganic, and organic dusts as indicated by examples in TLV's Appendix D]

Footnotes

(1) [Reserved]

(2) See Mineral Dusts Table.

(3) See 1926.58.

(4) See 1926.58.

* The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit.

** As determined from breathing-zone air samples.

a) Parts of vapor or gas per million parts of contaminated air by volume at 25C and 760 torr.

b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

c) [Reserved]
d) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound, measured as the metal, the CAS number for the metal is given--not CAS numbers for the individual compounds.
e-f) [Reserved]
g) For sectors excluded from 1926.1128 the limit is 10 ppm TWA.
i) [Reserved]
j) Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.
k) The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.
l) [Reserved]
m) Covers all organic and inorganic particulates not otherwise regulated. Same as Particulates Not Otherwise Regulated.
The 1970 TLV uses letter designations instead of a numerical value as follows:
A(1) [Reserved]
A(2) Polytetrafluoroethylene decomposition products. Because these products decompose in part by hydrolysis in alkaline solution, they can be quantitatively determined in air as fluoride to provide an index of exposure. No TLV is recommended pending determination of the toxicity of the products, but air concentrations should be minimal.
A(3) Gasoline and/or Petroleum Distillates. The composition of these materials varies greatly and thus a single TLV for all types of these materials is no longer applicable. The content of benzene, other aromatics and additives should be determined to arrive at the appropriate TLV.

E) Simple asphyxiants. The limiting factor is the available oxygen which shall be at least 19.5% and be within the requirements addressing explosion in part 1926.

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29 CFR 1926.56
ILLUMINATION

(a) General. Construction areas, ramps, runways, corridors, offices, shops, and storage areas shall be lighted to not less than the minimum illumination intensities listed in Table D-3 while any work is in progress:

TABLE D-3
MINIMUM ILLUMINATION
INTENSITIES IN FOOT-CANDLES

Foot-Candles	Area of Operation
5	General construction area lighting.
3	General construction areas, concrete placement, excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas: (Exception: minimum of 10 foot-calndles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines approved cap lights shall be acceptable for use in the tunnel heading)
10	General construction plant and shops (e.g., batch plants, screening plants, mechanical and electrical equipment rooms, carpenter shops, rigging lofts and active store rooms, mess halls, and indoor toilets and workrooms.)
30	First aid stations, infirmaries, and offices.

(b) Other areas. For areas or operations not covered above, refer to the American National Standard A11.1-1965, R1970, Practice for Industrial Lighting, for recommended values of illumination.

29 CFR 1926.57
VENTILATION

(a) General. Whenever hazardous substances such as dusts, fumes, mists, vapors, or gases exist or are produced in the course of construction work, their concentrations shall not exceed the limits specified in 1926.55(a). When ventilation is used as an engineering control method, the system shall be installed and operated according to the requirements of this section.

(b) Local exhaust ventilation. Local exhaust ventilation when used as described in (a) shall be designed to prevent dispersion into the air of dusts, fumes, mists, vapors, and gases in concentrations causing harmful exposure. Such exhaust systems shall be so designed that dusts, fumes, mists, vapors, or gases are not drawn through the work area of employees.

(c) Design and operation. Exhaust fans, jets, ducts, hoods, separators, and all necessary appurtenances, including refuse receptacles, shall be so designed, constructed, maintained and operated as to ensure the required protection by maintaining a volume and velocity of exhaust air sufficient to gather dusts, fumes, vapors, or gases from said equipment or process, and to convey them to suitable points of safe disposal, thereby preventing their dispersion in harmful quantities into the atmosphere where employees work.

(d) Duration of operations.

(1) The exhaust system shall be in operation continually during all operations which it is designed to serve. If the employee remains in the contaminated zone, the system shall continue to operate after the cessation of said operations, the length of time to depend upon the individual circumstances and effectiveness of the general ventilation system.

(2) Since dust capable of causing disability is, according to the best medical opinion, of microscopic size, tending to remain for hours in suspension in still air, it is essential that the exhaust system be continued in operation for a time after the work process or equipment served by the same shall have ceased, in order to ensure the removal of the harmful elements to the required extent. For the same reason, employees wearing respiratory equipment should not remove same immediately until the atmosphere seems clear.

(e) Disposal of exhaust materials. The air outlet from every dust separator, and the dusts, fumes, mists, vapors, or gases collected by an exhaust or ventilating system shall discharge to the outside atmosphere. Collecting systems which return air to work area may be used if concentrations which accumulate in the work area air do not result in harmful exposure to employees. Dust and refuse discharged from an exhaust system shall be disposed of in such a manner that it will not result in harmful exposure to employees.

(f) Abrasive blasting

(1) Definitions applicable to this paragraph

(i) Abrasive. A solid substance used in an abrasive blasting operation.

(ii) Abrasive-blasting respirator. A respirator constructed so that it covers the wearer's head, neck, and shoulders to protect the wearer from rebounding abrasive.

(iii) Blast cleaning barrel. A complete enclosure which rotates on an axis, or which has an internal moving tread to tumble the parts, in order to expose various surfaces of the parts to the action of an automatic blast spray.

(iv) Blast cleaning room. A complete enclosure in which blasting operations are performed and where the operator works inside of the room to operate the blasting nozzle and direct the flow of the abrasive material.

(v) Blasting cabinet. An enclosure where the operator stands outside and operates the blasting nozzle through an opening or openings in the enclosure.

(vi) Clean air. Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended periods of time.

(vii) Dust collector. A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.

(viii) Exhaust ventilation system. A system for removing contaminated air from a space, comprising two or more of the following elements (a) enclosure or hood, (b) duct work, (c) dust collecting equipment, (d) exhauster, and (e) discharge stack.

(ix) Particulate-filter respirator. An air purifying respirator, commonly referred to as a dust or a fume respirator, which removes most of the dust or fume from the air passing through the device.

(x) Respirable dust. Airborne dust in sizes capable of passing through the upper respiratory system to reach the lower lung passages.

(xi) Rotary blast cleaning table. An enclosure where the pieces to be cleaned are positioned on a rotating table and are passed automatically through a series of blast sprays.

(xii) Abrasive blasting. The forcible application of an abrasive to a surface by pneumatic pressure, hydraulic pressure, or centrifugal force.

(2) Dust hazards from abrasive blasting.

(i) Abrasives and the surface coatings on the materials blasted are shattered and pulverized during blasting operations and the dust formed will contain particles of respirable size. The composition and toxicity of the dust from these sources shall be considered in making an evaluation of the potential health hazards.

(ii) The concentration of respirable dust or fume in the breathing zone of the abrasive-blasting operator or any other worker shall be kept below the levels specified in 1926.55 or other pertinent sections of this part.

(iii) Organic abrasives which are combustible shall be used only in automatic systems. Where flammable or explosive dust mixtures may be present, the construction of the equipment, including the exhaust system and all electric wiring, shall conform to the requirements of American National Standard Installation of Blower and Exhaust Systems for Dust, Stock, and Vapor Removal or Conveying, Z33.1-1961 (NFPA 91-1961), and Suubpart S of this part. The blast nozzle shall be bonded and grounded to prevent the build up of static charges. Where flammable or explosive dust mixtures may be present, the abrasive blasting enclosure, the ducts, and the dust collector shall be constructed with loose panels or explosion venting areas, located on sides away from any occupied area, to provide for pressure relief in case of explosion, following the principles set forth in the National Fire Protection Association Explosion Venting Guide. NFPA 68-1954.

(3) Blast-cleaning enclosures.

(i) Blast-cleaning enclosures shall be exhaust ventilated in such a way that a continuous inward flow of air will be maintained at all openings in the enclosure during the blasting operation.

(a) All air inlets and access openings shall be baffled or so arranged that by the combination of inward air flow and baffling the escape of abrasive or dust particules into an adjacent work area will be minimized and visible spurts of dust will not be observed.

(b) The rate of exhaust shall be sufficient to provide prompt clearance of the dust-laden air within the enclosure after the cessation of blasting.

(c) Before the enclosure is opened, the blast shall be turned off and the exhaust system shall be run for a sufficient period of time to remove the dusty air within the enclosure.

(d) Safety glass protected by screening shall be used in observation windows, where hard deep-cutting abrasives are used.

(e) Slit abrasive-resistant baffles shall be installed in multiple sets at all small access openings where dust might escape, and shall be inspected regularly and replaced when needed.

(1) Doors shall be flanged and tight when closed.

(2) Doors on blast-cleaning rooms shall be operable from both inside and outside, except that where there is a small operator access door, the large work access door may be closed or opened from the outside only.

(4) Exhaust ventilation systems.

(i) The construction, installation, inspection, and maintenance of exhaust systems shall conform to the principles and requirements set forth in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, and ANSI Z33.1-1961.

(a) When dust leaks are noted, repairs shall be made as soon as possible.

(b) The static pressure drop at the exhaust ducts leading from the equipment shall be checked when the installation is completed and periodically thereafter to assure continued satisfactory operation. Whenever an appreciable change in the pressure drop indicates a partial blockage, the system shall be cleaned and returned to normal operating condition.

(ii) In installations where the abrasive is recirculated, the exhaust ventilation system for the blasting enclosure shall not be relied upon for the removal of fines from the spent abrasive instead of an abrasive separator. An abrasive separator shall be provided for the purpose.

(iii) The air exhausted from blast-cleaning equipment shall be discharged through dust collecting equipment. Dust collectors shall be set up so that the accumulated dust can be emptied and removed without contaminating other working areas.

(5) Personal protective equipment.

(i) Employers must use only respirators approved by NIOSH under 42 CFR part 84 for protecting employees from dusts produced during abrasive-blasting operations.

(ii) Abrasive-blasting respirators shall be worn by all abrasive-blasting operators:

(a) When working inside of blast-cleaning rooms, or

(b) When using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure, or

(c) Where concentrations of toxic dust dispersed by the abrasive blasting may exceed the limits set in 1926.55 or other pertinent part sections of this part and the nozzle and blast are not physically separated from the operator in an exhaust-ventilated enclosure.

(iii) Properly fitted particulate-filter respirators, commonly referred to as dust-filter respirators, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust ventilation, or other means. The respirators used must be approved by NIOSH under 42 CFR part 84 for protection against the specific type of dust encountered.

(iv) A respiratory protection program as defined and described in 1926.103, shall be established wherever it is necessary to use respiratory protective equipment.

(v) Operators shall be equipped with heavy canvas or leather gloves and aprons or equivalent protection to protect them from the impact of abrasives. Safety shoes shall be worn to protect against foot injury where heavy pieces of work are handled.

(a) Safety shoes shall conform to the requirements of American National Standard for Men's Safety-Toe Footwear, Z41.1-1967.

(b) Equipment for protection of the eyes and face shall be supplied to the operator when the respirator design does not provide such protection and to any other personnel working in the vicinity of abrasive blasting operations. This equipment shall conform to the requirements of 1926.102.

(6) Air supply and air compressors. Air for abrasive-blasting respirators must be free of harmful quantities of dusts, mists, or noxious gases, and must meet the requirements for supplied-air quality and use specified in 29 CFR 1910.134(i).

(7) Operational procedures and general safety. Dust shall not be permitted to accumulate on the floor or on ledges outside of an abrasive-blasting enclosure, and dust spills shall be cleaned up promptly. Aisles and walkways shall be kept clear of steel shot or similar abrasive which may create a slipping hazard.

(8) Scope. This paragraph (a) applies to all operations where an abrasive is forcibly applied to a surface by pneumatic or hydraulic pressure, or by centrifugal force. It does not apply to steam blasting, or steam cleaning, or hydraulic cleaning methods where work is done without the aid of abrasives.

(g) Grinding, polishing, and buffing operations

(1) Definitions applicable to this paragraph

(i) Abrasive cutting-off wheels. Organic-bonded wheels, the thickness of which is not more than one forty-eighth of their diameter for those up to, and including, 20 inches in diameter, and not more than one-sixtieth of their diameter for those larger than 20 inches in diameter, used for a multitude of operations variously known as cutting, cutting off, grooving, slotting, coping, and jointing, and the like. The wheels may be "solid" consisting of organic-bonded abrasive material throughout, "steel centered" consisting of a steel disc with a rim of organic-bonded material moulded around the periphery, or of the "inserted tooth" type consisting of a steel disc with organic-bonded abrasive teeth or inserts mechanically secured around the periphery.

(ii) Belts. All power-driven, flexible, coated bands used for grinding, polishing, or buffing purposes.

(iii) Branch pipe. The part of an exhaust system piping that is connected directly to the hood or enclosure.

(iv) Cradle. A movable fixture, upon which the part to be ground or polished is placed.

(v) Disc wheels. All power-driven rotatable discs faced with abrasive materials, artificial or natural, and used for grinding or polishing on the side of the assembled disc.

(vi) Entry loss. The loss in static pressure caused by air flowing into a duct or hood. It is usually expressed in inches of water gauge.

(vii) Exhaust system. A system consisting of branch pipes connected to hoods or enclosures, one or more header pipes, an exhaust fan, means for separating solid contaminants from the air flowing in the system, and a discharge stack to outside.

(viii) Grinding wheels. All power-driven rotatable grinding or abrasive wheels, except disc wheels as defined in this standard, consisting of abrasive particles held together by artificial or natural bonds and used for peripheral grinding.

(ix) Header pipe (main pipe). A pipe into which one or more branch pipes enter and which connects such branch pipes to the remainder of the exhaust system.

(x) Hoods and enclosures. The partial or complete enclosure around the wheel or disc through which air enters an exhaust system during operation.

(xi) Horizontal double-spindle disc grinder. A grinding machine carrying two power-driven, rotatable, coaxial, horizontal spindles upon the inside ends of which are mounted abrasive disc wheels used for grinding two surfaces simultaneously.

(xii) Horizontal single-spindle disc grinder. A grinding machine carrying an abrasive disc wheel upon one or both ends of a power-driven, rotatable single horizontal spindle.

(xiii) Polishing and buffing wheels. All power-driven rotatable wheels composed all or in part of textile fabrics, wood, felt, leather, paper, and may be coated with abrasives on the periphery of the wheel for purposes of polishing, buffing, and light grinding.

(xiv) Portable grinder. Any power-driven rotatable grinding, polishing, or buffing wheel mounted in such manner that it may be manually manipulated.

(xv) Scratch brush wheels. All power-driven rotatable wheels made from wire or bristles, and used for scratch cleaning and brushing purposes.

(xvi) Swing-frame grinder. Any power-driven rotatable grinding, polishing, or buffing wheel mounted in such a manner that the wheel with its supporting framework can be manipulated over stationary objects.

(xvii) Velocity pressure (vp). The kinetic pressure in the direction of flow necessary to cause a fluid at rest to flow at a given velocity. It is usually expressed in inches of water gauge.

(xviii) Vertical spindle disc grinder. A grinding machine having a vertical, rotatable power-driven spindle carrying a horizontal abrasive disc wheel.

(2) Application. Wherever dry grinding, dry polishing or buffing is performed, and employee exposure, without regard to the use of respirators, exceeds the permissible exposure limits prescribed in 1926.55 or other pertinent sections of this part, a local exhaust ventilation system shall be provided and used to maintain employee exposures within the prescribed limits.

(3) Hood and branch pipe requirements.

(i) Hoods connected to exhaust systems shall be used, and such hoods shall be designed, located, and placed so that the dust or dirt particles shall fall or be projected into the hoods in the direction of the air flow. No wheels, discs, straps, or belts shall be operated in such manner and in such direction as to cause the dust and dirt particles to be thrown into the operator's breathing zone.

(ii) Grinding wheels on floor stands, pedestals, benches, and special-purpose grinding machines and abrasive cutting-off wheels shall have not less than the minimum exhaust volumes shown in Table D-57.1 with a recommended minimum duct velocity of 4,500 feet per minute in the branch and 3,500 feet per minute in the main. The entry losses from all hoods except the vertical-spindle disc grinder hood, shall equal 0.65 velocity pressure for a straight takeoff and 0.45 velocity pressure for a tapered takeoff. The entry loss for the vertical-spindle disc grinder hood is shown in figure D-57.1 (following paragraph (b) of this section).

TABLE D-57.1
GRINDING & ABRASIVE CUTTING-OFF WHEELS

Wheel diameter (inches)	Wheel width (inches)	Minimum exhaust volume (feet (3)/min.)
To 9	1 1/2	220
Over 9 to 16	2	390
Over 16 to 19	3	500
Over 19 to 24	4	610
Over 24 to 30	5	880
Over 30 to 36	6	1,200

For any wheel wider than wheel diameters shown in Table D-57.1, increase the exhaust volume by the ratio of the new width to the width shown.
Example:

If wheel width=4 1/2 inches, then

4.5 divided by 4 X 610=686 (rounded to 690).

(iii) Scratch-brush wheels and all buffing and polishing wheels mounted on floor stands, pedestals, benches, or special-purpose machines shall have not less than the minimum exhaust volume shown in Table D-57.2.

TABLE D-57.2
BUFFING & POLISHING WHEELS

Wheel diameter (inches)	Wheel width (inches)	Minimum exhaust volume (feet (3)/min.)
To 9	2	300
Over 9 to 16	3	500
Over 16 to 19	4	610
Over 19 to 24	5	740
Over 24 to 30	6	1,040
Over 30 to 36	6	1,200

(iv) Grinding wheels or discs for horizontal single-spindle disc grinders shall be hooded to collect the dust or dirt generated by the grinding operation and the hoods shall be connected to branch pipes having exhaust volumes as shown in Table D-57.3.

TABLE D-57.3
HORIZONTAL SINGLE-SPINDLE DISC GRINDER

Disc diameter (inches)	Exhaust volume (cu. ft./min.)
Up to 12	220
Over 12 to 19	390
Over 19 to 30	610
Over 30 to 36	880

(v) Grinding wheels or discs for horizontal double-spindle disc grinders shall have a hood enclosing the grinding chamber and the hood shall be connected to one or more branch pipes having exhaust volumes as shown in Table D-57.4.

TABLE D-57.4
HORIZONTAL DOUBLE-SPINDLE DISC GRINDER

Disc diameter (inches)	Exhaust volume (cu. ft./min.)
Up to 19	610
Over 19 to 25	880
Over 25 to 30	1,200
Over 30 to 53	1,770
Over 53 to 72	6,280

(vi) Grinding wheels or discs for vertical single-spindle disc grinders shall be encircled with hoods to remove the dust generated in the operation. The hoods shall be connected to one or more branch pipes having exhaust volumes as shown in Table D-57.5.

TABLE D-57.5
VERTICAL SPINDLE DISC GRINDER

Disc diameter (inches)	One-half or more of disc covered		Disc not covered	
	Number (1)	Exhaust foot (3)/min.	Number (1)	Exhaust foot (3)/min.
Up to 20	1	500	2	780
Over 20 to 30	2	780	2	1,480
Over 30 to 53	2	1,770	4	3,530
Over 53 to 72	2	3,140	5	6,010

Footnote(1) Number of exhaust outlets around periphery of hood, or equal distribution provided by other means.

(vii) Grinding and polishing belts shall be provided with hoods to remove dust and dirt generated in the operations and the hoods shall be connected to branch pipes having exhaust volumes as shown in Table D-57.6.

TABLE D-57.6
GRINDING AND POLISHING BELTS

Belts width (inches)	Exhaust volume (cu. ft./min.)
Up to 3	220
Over 3 to 5	300
Over 5 to 7	390
Over 7 to 9	500
Over 9 to 11	610
Over 11 to 13	740

(viii) Cradles and swing-frame grinders. Where cradles are used for handling the parts to be ground, polished, or buffed, requiring large partial enclosures to house the complete operation, a minimum average air velocity of 150 feet per minute shall be maintained over the entire opening of the enclosure. Swing-frame grinders shall also be exhausted in the same manner as provided for cradles. (See fig. G-3)

(ix) Where the work is outside the hood, air volumes must be increased as shown in American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960 (section 4, exhaust hoods).

(4) Exhaust systems.

(i) Exhaust systems for grinding, polishing, and buffing operations should be designed in accordance

with American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(ii) Exhaust systems for grinding, polishing, and buffing operations shall be tested in the manner described in American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(iii) All exhaust systems shall be provided with suitable dust collectors.

(5) Hood and enclosure design.

(i) (a) It is the dual function of grinding and abrasive cutting-off wheel hoods to protect the operator from the hazards of bursting wheels as well as to provide a means for the removal of dust and dirt generated. All hoods shall be not less in structural strength than specified in the American National Standard Safety Code for the Use, Care, and Protection of Abrasive Wheels, B7.1-1970.

(b) Due to the variety of work and types of grinding machines employed, it is necessary to develop hoods adaptable to the particular machine in question, and such hoods shall be located as close as possible to the operation.

(ii) Exhaust hoods for floor stands, pedestals, and bench grinders shall be designed in accordance with figure G-2. The adjustable tongue shown in the figure shall be kept in working order and shall be adjusted within one-fourth inch of the wheel periphery at all times.

(iii) Swing-frame grinders shall be provided with exhaust booths as indicated in figure G-3.

(iv) Portable grinding operations, whenever the nature of the work permits, shall be conducted within a partial enclosure. The opening in the enclosure shall be no larger than is actually required in the operation and an average face air velocity of not less than 200 feet per minute shall be maintained.

(v) Hoods for polishing and buffing and scratch-brush wheels shall be constructed to conform as closely to figure D-57.4 as the nature of the work will permit.

(vi) Cradle grinding and polishing operations shall be performed within a partial enclosure similar to figure G-5. The operator shall be positioned outside the working face of the opening of the enclosure. The face opening of the enclosure should not be any greater in area than that actually required for the performance of the operation and the average air velocity into the working face of the enclosure shall not be less than 150 feet per minute.

(vii) Hoods for horizontal single-spindle disc grinders shall be constructed to conform as closely as possible to the hood shown in figure D-57.6. It is essential that there be a space between the back of the wheel and the hood, and a space around the periphery of the wheel of at least 1 inch in order to permit the suction to act around the wheel periphery. The opening on the side of the disc shall be no larger than is required for the grinding operation, but must never be less than twice the area of the branch outlet.

(vii) Horizontal double-spindle disc grinders shall have a hood encircling the wheels and grinding chamber similar to that illustrated in figure D-57.7. The openings for passing the work into the grinding chamber should be kept as small as possible, but must never be less than twice the area of the branch outlets.

(ix) Vertical-spindle disc grinders shall be encircled with a hood so constructed that the heavy dust is drawn off a surface of the disc and the lighter dust exhausted through a continuous slot at the top of the hood as shown in figure D-57.1.

(x) Grinding and polishing belt hoods shall be constructed as close to the operation as possible. The hood should extend almost to the belt, and 1-inch wide openings should be provided on either side. Figure G-8 shows a typical hood for a belt operation.

FIGURE D-57.1

VERTICAL SPINDLE DISC GRINDER EXHAUST HOOD AND BRANCH PIPE CONNECTIONS

(For Figure D-57.1, see printed copy)

Dia D. inches		Exhaust E		Volume Exhausted at 4,500 ft/min	
Min.	Max.	No Pipes	Dia.	ft3/min	Note
	20	1	4 1/4	500	When one-half or more of the disc can be hooded, use exhaust ducts as shown at the left.
Over 20	30	2	4	780	
Over 30	72	2	6	1,770	
Over 53	72	2	8	3,140	
	20	2	4	780	When no hood can be used over disc, use exhaust ducts as shown at left.
Over 20	20	2	4	780	
Over 30	30	2	5 1/2	1,480	
Over 53	53	4	6	3,530	
	72	5	7	6,010	

Entry loss=1.0 slot velocity pressure + 0.5 branch velocity pressure.
Minimum slot velocity=2,000 ft/min- 1/2 -inch slot width.

FIGURE D-57.2

STANDARD GRINDER HOOD

(For Figure D-57.2, see printed copy)

Wheel dimension, inches			Exhaust outlet, inches E	Volume of air at 4,500 ft/min
Diameter		Width, Max		
Min=d	Max=D			
	9	1 1/2	3	220
Over 9	16	2	4	390
Over 16	19	3	4 1/2	500
Over 19	24	4	5	610
Over 24	30	5	6	880
Over 30	36	6	7	1,200

Entry loss = 0.45 velocity pressure for tapered takeoff 0.65 velocity pressure for straight takeoff.

FIGURE D-57.3

A METHOD OF APPLYING AN EXHAUST ENCLOSURE TO SWING-FRAME GRINDERS

(For Figure D-57.3, see printed copy)

FIGURE D-57.4

STANDARD BUFFING AND POLISHING HOOD

(For Figure D-57.4, see printed copy)

Standard Buffing and Polishing Hood

Wheel dimension, inches			Exhaust outlet, inches E	Volume of air at 4,500 ft/min
Diameter		Width, Max		
Min=d	Max=D			
	9	2	3 1/2	300
Over 9	16	3	4	500
Over 16	19	4	5	610
Over 19	24	5	5 1/2	740
Over 24	30	6	6 1/2	1.040
Over 30	36	6	7	1.200

Entry loss = 0.15 velocity pressure for tapered takeoff; 0.65 velocity pressure for straight takeoff.

FIGURE D-57.5

CRADLE POLISHING OR GRINDING ENCLOSURE

(For Figure D-57.5, see printed copy)

Table D-57.12

Maximum Allowable Size of Containers and Portable Tanks

Container type	Flammable liquids			Combustible liquids	
	Class IA	Class IB	Class IC	Class II	Class III
Glass or approved plastic	1 pt	1 qt	1 gal	1 gal	1 gal.
Metal (other than DOT drums)	1 gal	5 gal	5 gal	5 gal	5 gal.
Safety cans	2 gal	5 gal	5 gal	5 gal	5 gal.
Metal drums (DOT spec.)	60 gal	60 gal	60 gal	60 gal	60 gal.
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal.

Container exemptions: (a) Medicines, beverages, foodstuffs, cosmetics, and other common consumer items, when packaged according to commonly accepted practices, shall be exempt from the requirements of 1910.106(d)(2) (i) and (ii).

FIGURE G-6

HORIZONTAL SINGLE-SPINDLE DISC GRINDER EXHAUST HOOD AND BRANCH PIPE CONNECTIONS

(For Figure G-6, see printed copy)

Dia D, inches		Exhaust E, dia. inches	Volume exhausted at 4, 500 ft/min ft3/min
Min.	Max.		
	12	3	220
Over 12	19	4	390
Over 19	30	5	610
Over 30	36	6	880

Note: If grinding wheels are used for disc grinding purposes, hoods must conform to structural strength and materials as described in 9.1.
Entry loss = 0.45 velocity pressure for tapered takeoff.

FIGURE G-7
HORIZONTAL DOUBLE-SPINDLE DISC GRINDER EXHAUST HOOD AND BRANCH PIPE CONNECTIONS
(For Figure G-7, see printed copy)

Disc dia. inches		Exhaust E		Volume exhaust at 4,500 ft/min. ft3/min	Note
Min.	Max.	No Pipes	Dia.		
	19	1	5	610	
Over 19	25	1	6	880	When width ``W'' permits, exhaust ducts should be as near heaviest grinding as possible.
Over 25	30	1	7	1,200	
Over 30	53	2	6	1,770	
Over 53	72	4	8	6,280	

Entry loss = 0.45 velocity pressure for tapered takeoff.

FIGURE G-8
A TYPICAL HOOD FOR A BELT OPERATION
(For Figure G-8, see printed copy)

Belt width W. Inches	Exhaust volume. ft.1/min
Up to 3	220
3 to 5	300
5 to 7	390
7 to 9	500
9 to 11	610
11 to 13	740

Minimum duct velocity = 4,500 ft/min branch, 3,500 ft/min main.
Entry loss = 0.45 velocity pressure for tapered takeoff; 0.65 velocity pressure for straight takeoff.

(6) Scope. This paragraph (b), prescribes the use of exhaust hood enclosures and systems in removing dust, dirt, fumes, and gases generated through the grinding, polishing, or buffing of ferrous and nonferrous metals.

(h) Spray finishing operations

(1) Definitions applicable to this paragraph

(i) Spray-finishing operations. Spray-finishing operations are employment of methods wherein organic or inorganic materials are utilized in dispersed form for deposit on surfaces to be coated, treated, or cleaned. Such methods of deposit may involve either automatic, manual, or electrostatic deposition but do not include metal spraying or metallizing, dipping, flow coating, roller coating, tumbling, centrifuging, or spray washing and degreasing as conducted in self-contained washing and degreasing machines or systems.

(ii) Spray booth. Spray booths are defined and described in 1926.66(a). (See sections 103, 104, and 105 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969).

(iii) Spray room. A spray room is a room in which spray-finishing operations not conducted in a spray booth are performed separately from other areas.

(iv) Minimum maintained velocity. Minimum maintained velocity is the velocity of air movement which must be maintained in order to meet minimum specified requirements for health and safety.

(2) Location and application. Spray booths or spray rooms are to be used to enclose or confine all operations. Spray-finishing operations shall be located as provided in sections 201 through 206 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969.

(3) Design and construction of spray booths.

(i) Spray booths shall be designed and constructed in accordance with 1926.66(b)(1) through (4) and (6) through (10) (see sections 301-304 and 306-310 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969), for general construction specifications. For a more detailed discussion of fundamentals relating to this subject, see ANSI Z9.2-1960

(a) Lights, motors, electrical equipment, and other sources of ignition shall conform to the requirements of 1926.66 (b)(10) and (c). (See section 310 and chapter 4 of the Standard for Spray Finishing Using Flammable and Combustible Materials NFPA No. 33-1969.)

(b) In no case shall combustible material be used in the construction of a spray booth and supply or exhaust duct connected to it.

(ii) Unobstructed walkways shall not be less than 6 1/2 feet high and shall be maintained clear of obstruction from any work location in the booth to a booth exit or open booth front. In booths where the open front is the only exit, such exits shall be not less than 3 feet wide. In booths having multiple exits, such exits shall not be less than 2 feet wide, provided that the maximum distance from the work location to the exit is 25 feet or less. Where booth exits are provided with doors, such doors shall open outward from the booth.

(iii) Baffles, distribution plates, and dry-type overspray collectors shall conform to the requirements of 1926.66(b) (4) and (5). (See sections 304 and 305 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969.)

(a) Overspray filters shall be installed and maintained in accordance with the requirements of

1926.66 (b)(5), (see section 305 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969), and shall only be in a location easily accessible for inspection, cleaning, or replacement.

(b) Where effective means, independent of the overspray filters, are installed which will result in design air distribution across the booth cross section, it is permissible to operate the booth without the filters in place.

(iv) (a) For wet or water-wash spray booths, the water-chamber enclosure, within which intimate contact of contaminated air and cleaning water or other cleaning medium is maintained, if made of steel, shall be 18 gage or heavier and adequately protected against corrosion.

(b) Chambers may include scrubber spray nozzles, headers, troughs, or other devices. Chambers shall be provided with adequate means for creating and maintaining scrubbing action for removal of particulate matter from the exhaust air stream.

(v) Collecting tanks shall be of welded steel construction or other suitable non-combustible material. If pits are used as collecting tanks, they shall be concrete, masonry, or other material having similar properties.

(a) Tanks shall be provided with weirs, skimmer plates, or screens to prevent sludge and floating paint from entering the pump suction box. Means for automatically maintaining the proper water level shall also be provided. Fresh water inlets shall not be submerged. They shall terminate at least one pipe diameter above the safety overflow level of the tank.

(b) Tanks shall be so constructed as to discourage accumulation of hazardous deposits.

(vi) Pump manifolds, risers, and headers shall be adequately sized to insure sufficient water flow to provide efficient operation of the water chamber.

(4) Design and construction of spray rooms.

(i) Spray rooms, including floors, shall be constructed of masonry, concrete, or other noncombustible material.

(ii) Spray rooms shall have noncombustible fire doors and shutters.

(iii) Spray rooms shall be adequately ventilated so that the atmosphere in the breathing zone of the operator shall be maintained in accordance with the requirements of subparagraph (6)(ii) of this paragraph.

(iv) Spray rooms used for production spray-finishing operations shall conform to the requirements for spray booths.

(5) Ventilation.

(i) Ventilation shall be provided in accordance with provisions of 1926.66(d) (see chapter 5 of the Standard for Spray Finishing Using Flammable or Combustible Materials, NFPA No. 33-1969), and in accordance with the following:

(a) Where a fan plenum is used to equalize or control the distribution of exhaust air

movement through the booth, it shall be of sufficient strength or rigidity to withstand the differential air pressure or other superficially imposed loads for which the equipment is designed and also to facilitate cleaning. Construction specifications shall be at least equivalent to those of subdivision (iii) of this subparagraph.

(ii) Inlet or supply ductwork used to transport makeup air to spray booths or surrounding areas shall be constructed of noncombustible materials.

(a) If negative pressure exists within inlet ductwork, all seams and joints shall be sealed if there is a possibility of infiltration of harmful quantities of noxious gases, fumes, or mists from areas through which ductwork passes.

(b) Inlet ductwork shall be sized in accordance with volume flow requirements and provide design air requirements at the spray booth.

(c) Inlet ductwork shall be adequately supported throughout its length to sustain at least its own weight plus any negative pressure which is exerted upon it under normal operating conditions.

(iii) [Reserved]

(a) Exhaust ductwork shall be adequately supported throughout its length to sustain its weight plus any normal accumulation in interior during normal operating conditions and any negative pressure exerted upon it.

(b) Exhaust ductwork shall be sized in accordance with good design practice which shall include consideration of fan capacity, length of duct,number of turns and elbows, variation in size, volume, and character of materials being exhausted. See American National Standard Z9.2-1960 for further details and explanation concerning elements of design.

(c) Longitudinal joints in sheet steel ductwork shall be either lock-seamed, riveted, or welded. For other than steel construction, equivalent securing of joints shall be provided.

(d) Circumferential joints in ductwork shall be substantially fastened together and lapped in the direction of airflow. At least every fourth joint shall be provided with connecting flanges, bolted together, or of equivalent fastening security.

(e) Inspection or clean-out doors shall be provided for every 9 to 12 feet of running length for ducts up to 12 inches in diameter, but the distance between cleanout doors may be greater for larger pipes. (See 8.3.21 of American National Standard Z9.1-1951.) A clean-out door or doors shall be provided for servicing the fan, and where necessary, a drain shall be provided.

(f) Where ductwork passes through a combustible roof or wall, the roof or wall shall be protected at the point of penetration by open space or fire-resistive material between the duct and the roof or wall. When ducts pass through firewalls, they shall be provided with automatic fire dampers on both sides of the wall, except that three-eighth-inch steel plates may be used in lieu of automatic fire dampers for ducts not exceeding 18 inches in diameter.

(g) Ductwork used for ventilating any process covered in this standard shall not be connected to ducts ventilating any other process or any chimney or flue used for conveying any products of combustion.

(6) Velocity and air flow requirements.

(i) Except where a spray booth has an adequate air replacement system, the velocity of air into all openings of a spray booth shall be not less than that specified in Table D-57.7 for the operating conditions specified. An adequate air replacement system is one which introduces replacement air upstream or above the object being sprayed and is so designed that the velocity of air in the booth cross section is not less than that specified in Table D-57.7 when measured upstream or above the object being sprayed.

TABLE D-57.7
MINIMUM MAINTAINED VELOCITIES INTO SPRAY BOOTHS

Operating conditions for objects completely inside booth	Crossdraft, f.p.m.	Airflow velocities, f.p.m. Design	Range
Electrostatic and automatic airless operation contained in booth without operator.	Negligible	50 large booth	50-75
Air-operated guns, manual or automatic	Up to 50	100 small booth	75-125
		100 large booth	75-125
Air-operated guns, manual or automatic	Up to 100	150 small booth	125-175
		150 large booth	125-175
		200 small booth	150-250

Notes:

(1) Attention is invited to the fact that the effectiveness of the spray booth is dependent upon the relationship of the depth of the booth to its height and width.

(2) Crossdrafts can be eliminated through proper design and such design should be sought. Crossdrafts in excess of 100fpm (feet per minute) should not be permitted.

(3) Excessive air pressures result in loss of both efficiency and material waste in addition to creating a backlash that may carry overspray and fumes into adjacent work areas.

(4) Booths should be designed with velocities shown in the column headed ``Design.'' However, booths operating with velocities shown in the column headed ``Range'' are in compliance with this standard.

(ii) In addition to the requirements in subdivision (i) of this subparagraph the total air volume exhausted through a spray booth shall be such as to dilute solvent vapor to at least 25 percent of the lower explosive limit of the solvent being sprayed. An example of the method of calculating this volume is given below.

Example: To determine the lower explosive limits of the most common solvents used in spray finishing, see Table D-57.8. Column 1 gives the number of cubic feet of vapor per gallon of solvent and column 2 gives the lower explosive limit (LEL) in percentage by volume of air. Note that the quantity of solvent will be diminished by the quantity of solids and nonflammables contained in the finish.

To determine the volume of air in cubic feet necessary to dilute the vapor from 1 gallon of solvent to

25 percent of the lower explosive limit, apply the following formula:

Dilution volume required per gallon of solvent = 4 (100 - LEL) (cubic feet of vapor per gallon) divided by LEL

Using toluene as the solvent.

1. LEL of toluene from Table D-57.8, column 2, is 1.4 percent.

2. Cubic feet of vapor per gallon from Table D-57.8, column 1, is 30.4 cubic feet per gallon.

3. Dilution volume required = 4 (100 - 1.4) 30.4 divided by 1.4 = 8,564 cubic feet.

4. To convert to cubic feet per minute of required ventilation, multiply the dilution volume required per gallon of solvent by the number of gallons of solvent evaporated per minute.

TABLE D-57.8
LOWER EXPLOSIVE LIMIT OF SOME COMMONLY USED SOLVENTS

Solvent	Cubic feet per gallon of vapor of liquid at 70 deg. F.	Lower explosive limit in percent by volume of air at 70 deg. F.
	Column 1	Column 2
Acetone	44.0	2.6
Amyl Acetate (iso)	21.6	(1) 1.0
Amyl Alcohol (n)	29.6	1.2
Amyl Alcohol (iso)	29.6	1.2
Benzene	36.8	(1) 1.4
Butyl Acetate (n)	24.8	1.7
Butyl Alcohol (n)	35.2	1.4
Butyl Cellosolve	24.8	1.1
Cellosolve	33.6	1.8
Cellosolve Acetate	23.2	1.7
Cyclohexanone	31.2	(1) 1.1
1,1 Dichloroethylene	42.4	5.9
1,2 Dichloroethylene	42.4	9.7
Ethyl Acetate	32.8	2.5
Ethyl Alcohol	55.2	4.3
Ethyl Lactate	28.0	(1) 1.5
Methyl Acetate	40.0	3.1
Methyl Alcohol	80.8	7.3
Methyl Cellosolve	40.8	2.5
Methyl Ethyl Ketone	36.0	1.8
Methyl n-Propyl Ketone	30.4	1.5
Naphtha (VM&P) (76 deg. Naphtha)	22.4	0.9
Naphtha (100 deg. Flash) Safety Solvent - Stoddard Solvent	23.2	1.0
Propyl Acetate (n)	27.2	2.8
Propyl Acetate (iso)	28.0	1.1
Propyl Alcohol (n)	44.8	2.1
Propyl Alcohol (iso)	44.0	2.0
Toluene	30.4	1.4
Turpentine	20.8	0.8
Xylene (o)	26.4	1.0

_____:_____:_____
Footnote(1)At 212 deg. F.

(iii (a) When an operator is in a booth downstream of the object being sprayed, an air-supplied respirator or other type of respirator approved by NIOSH under 42 CFR Part 84 for the material being sprayed should be used by the operator.

(b) Where downdraft booths are provided with doors, such doors shall be closed when spray painting.

(7) Make-up air.

(i) Clean fresh air, free of contamination from adjacent industrial exhaust systems, chimneys, stacks, or vents, shall be supplied to a spray booth or room in quantities equal to the volume of air exhausted through the spray booth.

(ii) Where a spray booth or room receives make-up air through self-closing doors, dampers, or louvers, they shall be fully open at all times when the booth or room is in use for spraying. The velocity of air through such doors, dampers, or louvers shall not exceed 200 feet per minute. If the fan characteristics are such that the required air flow through the booth will be provided, higher velocities through the doors, dampers, or louvers may be used.

(iii (a) Where the air supply to a spray booth or room is filtered, the fan static pressure shall be calculated on the assumption that the filters are dirty to the extent that they require cleaning or replacement.

(b) The rating of filters shall be governed by test data supplied by the manufacturer of the filter. A pressure gage shall be installed to show the pressure drop across the filters. This gage shall be marked to show the pressure drop at which the filters require cleaning or replacement. Filters shall be replaced or cleaned whenever the pressure drop across them becomes excessive or whenever the air flow through the face of the booth falls below that specified in Table G-10.

(iv) (a) Means for heating make-up air to any spray booth or room, before or at the time spraying is normally performed, shall be provided in all places where the outdoor temperature may be expected to remain below 55 deg. F. for appreciable periods of time during the operation of the booth except where adequate and safe means of radiant heating for all operating personnel affected is provided. The replacement air during the heating seasons shall be maintained at not less than 65 deg. F. at the point of entry into the spray booth or spray room. When otherwise unheated make-up air would be at a temperature of more than 10 deg. F. below room temperature, its temperature shall be regulated as provided in section 3.6.3 of ANSI Z9.2-1960.

(b) As an alternative to an air replacement system complying with the preceding section, general heating of the building in which the spray room or booth is located may be employed provided that all occupied parts of the building are maintained at not less than 65 deg. F. when the exhaust system is in operation or the general heating system supplemented by other sources of heat may be employed to meet this requirement.

(c) No means of heating make-up air shall be located in a spray booth.

(d) Where make-up air is heated by coal or oil, the products of combustion shall not be allowed to mix with the make-up air, and the products of combustion shall be conducted outside the building through a flue terminating at a point remote from all points where make-up air enters the building.

(e) Where make-up air is heated by gas, and the products of combustion are not mixed with the make-up air but are conducted through an independent flue to a point outside the building remote from all points where make-up air enters the building, it is not necessary to comply with paragraph (f) of this subdivision.

(f) Where make-up air to any manually operated spray booth or room is heated by gas and the products of combustion are allowed to mix with the supply air, the following precautions must be taken:

(1) The gas must have a distinctive and strong enough odor to warn workmen in a spray booth or room of its presence if in an unburned state in the make-up air.

(2) The maximum rate of gas supply to the make-up air heater burners must not exceed that which would yield in excess of 200 p.p.m. (parts per million) of carbon monoxide or 2,000 p.p.m. of total combustible gases in the mixture if the unburned gas upon the occurrence of flame failure were mixed with all of the make-up air supplied.

(3) A fan must be provided to deliver the mixture of heated air and products of combustion from the plenum chamber housing the gas burners to the spray booth or room.

(8) Scope. Spray booths or spray rooms are to be used to enclose or confine all spray finishing operations covered by this paragraph (c). This paragraph does not apply to the spraying of the exteriors of buildings, fixed tanks, or similar structures, nor to small portable spraying apparatus not used repeatedly in the same location.

(i) Open surface tanks

(1) General.

(i) This paragraph applies to all operations involving the immersion of materials in liquids, or in the vapors of such liquids, for the purpose of cleaning or altering the surface or adding to or imparting a finish thereto or changing the character of the materials, and their subsequent removal from the liquid or vapor, draining, and drying. These operations include washing, electroplating, anodizing, pickling, quenching, dying, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, digesting, and other similar operations.

(ii) Except where specific construction specifications are prescribed in this section, hoods, ducts, elbows, fans, blowers, and all other exhaust system parts, components, and supports thereof shall be so constructed as to meet conditions of service and to facilitate maintenance and shall conform in construction to the specifications contained in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(2) Classification of open-surface tank operations.

(i) Open-surface tank operations shall be classified into 16 classes, numbered A-1 to D-4, inclusive.

(ii) Determination of class. Class is determined by two factors, hazard potential designated by a letter from A to D, inclusive, and rate of gas, vapor, or mist evolution designated by a number from 1 to 4, inclusive (for example, B.3).

(iii) Hazard potential is an index, on a scale of from A to D, inclusive,of the severity of the hazard associated with the substance contained in the tank because of the toxic, flammable, or explosive nature of the vapor,gas, or mist produced therefrom. The toxic hazard is determined from the concentration, measured in parts by volume of a gas or vapor, per million parts by volume of contaminated air (p.p.m.), or in milligrams of mist per cubic meter of air (mg./meter (3)), below which ill effects are unlikely to occur to the exposed worker. The concentrations shall be those in 1926.55 or other pertinent sections of this part.

(iv) The relative fire or explosion hazard is measured in degrees Fahrenheit in terms of the closed-cup flash point of the substance in the tank. Detailed information on the prevention of fire hazards in dip tanks may be found in Dip Tanks Containing Flammable or Combustible Liquids, NFPA No. 34-1966, National Fire Protection Association. Where the tank contains a mixture of liquids, other than organic solvents, whose effects are additive, the hygienic standard of the most toxic component (for example, the one having the lowest p.p.m. or mg./meter (3) shall be used, except where such substance constitutes an insignificantly small fraction of the mixture. For mixtures of organic solvents, their combined effect, rather than that of either individually, shall determine the hazard potential. In the absence of information to the contrary, the effects shall be considered as additive. If the sum of the ratios of the airborne concentration of each contaminant to the toxic concentration of that contaminant exceeds unity, the toxic concentration shall be considered to have been exceeded. (See Note A to subdivision (v) of this subparagraph.)

(v) Hazard potential shall be determined from Table D-57.9, with the value indicating greater hazard being used. When the hazardous material may be either a vapor with a threshold limit value (TLV) in p.p.m. or a mist with a TLV in mg./meter (3), the TLV indicating the greater hazard shall be used (for example, A takes precedence over B or C; B over C; C over D).

NOTE A:

(c1 divided by TLV1) + (c2 divided by TLV2) +
(c3 divided by TLV3) + ; . . .
(cN divided by TLVN) 1

where:

c = Concentration measured at the operation in p.p.m.

TABLE D-57.9

DETERMINATION OF HAZARD POTENTIAL

Hazard potential	Toxicity group: Gas or vapor (p.p.m.)	Toxicity group: Mist (mg./m(3))	Toxicity group: Flash point (in deg. F)
A	0-10	0-0.1	
B	11-100	0.11-1.0	Under 100
C	101-500	1.1-10	100-200
D	Over 500	Over 10	Over 200

(vi) Rate of gas, vapor, or mist evolution is a numerical index, on a scale of from 1 to 4, inclusive, both of the relative capacity of the tank to produce gas, vapor, or mist and of the relative energy with which it is projected or carried upwards from the tank. Rate is evaluated in terms of

(a) The temperature of the liquid in the tank in degrees Fahrenheit;

(b) The number of degrees Fahrenheit that this temperature is below the boiling point of the liquid in degrees Fahrenheit;

(c) The relative evaporation of the liquid in still air at room temperature in an arbitrary scale-fast, medium, slow, or nil; and

(d) The extent that the tank gases or produces mist in an arbitrary scale-high, medium, low, and nil. (See Table D-57.10, Note 2.) Gassing depends upon electrochemical or mechanical processes, the effects of which have to be individually evaluated for each installation (see Table D-57.10, Note 3).

(vii) Rate of evolution shall be determined from Table D-57.10. When evaporation and gassing yield different rates, the lowest numerical value shall be used.

TABLE D-57.10

DETERMINATION OF RATE OF GAS, VAPOR, OR MIST EVOLUTION (1)

Rate	Liquid Temp. Deg. F.	Degrees below boiling point	Relative evaporation (2)	Gassing (3)
1	Over 200	0-20	Fast	High.
2	150-200	21-50	Medium	Medium.
3	94-149	51-100	Slow	Low.
4	Under 94	Over 100	Nil	Nil.

Footnote(1) In certain classes of equipment, specifically vapor degreasers, an internal condenser or vapor level thermostat is used to prevent the vapor from leaving the tank during normal operation. In such cases, rate of vapor evolution from the tank into the workroom is not dependent upon the factors listed in the table, but rather upon abnormalities of operating procedure, such as carryout of vapors from excessively fast action, dragout of liquid by entrainment in parts, contamination of solvent by water and other materials, or improper heat balance. When operating procedure is excellent, effective rate of evolution may be taken as 4. When operating procedure is average, the effective rate of evolution may be taken as 3. When operation is poor, a rate of 2 or 1 is indicated, depending upon observed conditions.

Footnote(2) Relative evaporation rate is determined according to the methods described by A. K. Doolittle in Industrial and Engineering Chemistry, vol. 27, p. 1169, (3) where time for 100-percent evaporation is as follows: Fast: 0-3 hours; Medium: 3-12 hours; Slow: 12-50 hours; Nil: more than 50 hours.

Footnote(3) Gassing means the formation by chemical or electrochemical action of minute bubbles of gas under the surface of the liquid in the tank and is generally limited to aqueous solutions.

(3) Ventilation. Where ventilation is used to control potential exposures to workers as defined in

subparagraph (2)(iii) of this paragraph, it shall be adequate to reduce the concentration of the air contaminant to the degree that a hazard to the worker does not exist. Methods of ventilation are discussed in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(4) Control requirements.

(i) Control velocities shall conform to Table D-57.11 in all cases where the flow of air past the breathing or working zone of the operator and into the hoods is undisturbed by local environmental conditions, such as open windows, wall fans, unit heaters, or moving machinery.

(ii) All tanks exhausted by means of hoods which

(a) Project over the entire tank;

(b) Are fixed in position in such a location that the head of the workman, in all his normal operating positions while working at the tank, is in front of all hood openings; and

(c) Are completely enclosed on at least two sides, shall be considered to be exhausted through an enclosing hood.

(d) The quantity of air in cubic feet per minute necessary to be exhausted through an enclosing hood shall be not less than the product of the control velocity times the net area of all openings in the enclosure through which air can flow into the hood.

Table D-57.11

Control Velocities in Feet Per Minute (f.p.m.) for Undisturbed Locations

Class	Enclosing hood: One open side	Enclosing hood: Two open sides	Lateral exhaust (1)	Canopy hood(2): Three open sides	Canopy hood(2): Four open sides
B-1 and A-2	100	150	150	Do not use	Do not use
A-3(2), B-1, B-2, and C-1	75	100	100	125	175
A-3, C-2, and D-1(3)	65	90	75	100	150
B-4(2), C-3, and D-2(3)	50	75	50	75	125
A-4, C-4, D-3(3), and D-4(4)					

(1) See Table D-57.12 for computation of ventilation rate.
(2) Do not use canopy hood for Hazard Potential A processes.
(3) Where complete control of hot water is desired, design as next highest class.
(4) General room ventilation required.

(iii) All tanks exhausted by means of hoods which do not project over the entire tank, and in which the direction of air movement into the hood or hoods is substantially horizontal, shall be considered to be laterally exhausted. The quantity of air in cubic feet per minute necessary to be laterally exhausted per square foot of tank area in order to maintain the required control velocity shall be determined from Table D-57.12 for all variations in ratio of tank width (W) to tank length (L). The total quantity of air in cubic feet per minute required to be exhausted per tank shall be not less than

the product of the area of tank surface times the cubic feet per minute per square foot of tank area, determined from Table D-57.12.

(a) For lateral exhaust hoods over 42 inches wide, or where it is desirable to reduce the amount of air removed from the workroom, air supply slots or orifices shall be provided along the side or the center of the tank opposite from the exhaust slots. The design of such systems shall meet the following criteria:

(1) The supply air volume plus the entrained air shall not exceed 50 percent of the exhaust volume.

(2) The velocity of the supply airstream as it reaches the effective control area of the exhaust slot shall be less than the effective velocity over the exhaust slot area.

Table D-57.12

Minimum Ventilation Rate in Cubic Feet of Air Per Minute Per Square Foot of Tank Area for Lateral Exhaust

Required minimum control velocity, f.p.m. (from Table D-57.11)	C.f.m. per sq. ft. to maintain required minimum velocities at following ratios (tank width (W)/tank length (L)).(1),(2)				
	0.0-0.09	0.1-0.24	0.25-0.49	0.5-0.99	1.0-2.0
Hood along one side or two parallel sides of tank when one hood is against a wall or baffle.(2) Also for a manifold along tank centerline.(3)					
50	50	60	75	90	100
75	75	90	110	130	150
100	100	125	150	175	200
150	150	190	225	260	300
Hood along one side or two parallel sides of free standing tank not against wall or baffle.					
50	75	90	100	110	125
75	110	130	150	170	190
100	150	175	200	225	250
150	225	260	300	340	375

(1) It is not practicable to ventilate across the long dimension of a tank whose ratio W/L exceeds 2.0.

It is undesirable to do so when W/L exceeds 1.0. For circular tanks with lateral exhaust along up to 1/2 the circumference, use W/L=1.0; for over one-half the circumference use W/L=0.5.

(2) Baffle is a vertical plate the same length as the tank, and with the top of the plate as high as the tank is wide. If he exhaust hood is on the side of a tank against a building wall or close to it, it is perfectly baffled.

(3) Use W/2 as tank width in computing when manifold is along centerline, or when hoods are used on two parallel sides of a tank.

Tank Width (W) means the effective width over which the hood must pull air to operate (for example, where the hood face is set back from the edge of the tank, this set back must be added in measuring tank width). The surface area of tanks can frequently be reduced and better control obtained (particularly on conveyorized systems) by using covers extending from the upper edges of the slots toward the center of the tank.

(3) The vertical height of the receiving exhaust hood, including any baffle, shall not be less than one-quarter the width of the tank.

(4) The supply airstream shall not be allowed to impinge on obstructions between it and the exhaust slot in such a manner as to significantly interfere with the performance of the exhaust hood.

(5) Since most failure of push-pull systems result from excessive supply air volumes and pressures, methods of measuring and adjusting the supply air shall be provided. When satisfactory control has been achieved, the adjustable features of the hood shall be fixed so that they will not be altered.

(iv) All tanks exhausted by means of hoods which project over the entire tank, and which do not conform to the definition of enclosing hoods, shall be considered to be overhead canopy hoods. The quantity of air in cubic feet per minute necessary to be exhausted through a canopy hood shall be not less than the product of the control velocity times the net area of all openings between the bottom edges of the hood and the top edges of the tank.

(v) The rate of vapor evolution (including steam or products of combustion) from the process shall be estimated. If the rate of vapor evolution is equal to or greater than 10 percent of the calculated exhaust volume required, the exhaust volume shall be increased in equal amount.

(5) Spray cleaning and degreasing. Wherever spraying or other mechanical means are used to disperse a liquid above an open-surface tank, control must be provided for the airborne spray. Such operations shall be enclosed as completely as possible. The inward air velocity into the enclosure shall be sufficient to prevent the discharge of spray into the workroom. Mechanical baffles may be used to help prevent the discharge of spray. Spray painting operations are covered by paragraph (c) of this section.

(6) Control means other than ventilation. Tank covers, foams, beads, chips, or other materials floating on the tank surface so as to confine gases, mists, or vapors to the area under the cover or to the foam, bead, or chip layer; or surface tension depressive agents added to the liquid in the tank to minimize mist formation, or any combination thereof, may all be used as gas, mist, or vapor control means for open-surface tank operations, provided that they effectively reduce the concentrations of hazardous materials in the vicinity of the worker below the limits set in accordance with subparagraph (2) of this paragraph.

(7) System design.

(i) The equipment for exhausting air shall have sufficient capacity to produce the flow of air required in each of the hoods and openings of the system.

(ii) The capacity required in subdivision (i) of this subparagraph shall be obtained when the airflow producing equipment is operating against the following pressure losses, the sum of which is the static pressure:

(a) Entrance losses into the hood.

(b) Resistance to airflow in branch pipe including bends and transformations.

(c) Entrance loss into the main pipe.

(d) Resistance to airflow in main pipe including bends and transformations.

(e) Resistance of mechanical equipment; that is, filters, washers, condensers, absorbers, etc., plus their entrance and exit losses.

(f) Resistance in outlet duct and discharge stack.

(iii) Two or more operations shall not be connected to the same exhaust system where either one or the combination of the substances removed may constitute a fire, explosion, or chemical reaction hazard in the duct system. Traps or other devices shall be provided to insure that condensate in ducts does not drain back into any tank.

(iv) The exhaust system, consisting of hoods, ducts, air mover, and discharge outlet, shall be designed in accordance with American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, or the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists 1970. Airflow and pressure loss data provided by the manufacturer of any air cleaning device shall be included in the design calculations.

(8) Operation.

(i) The required airflow shall be maintained at all times during which gas, mist, or vapor is emitted from the tank, and at all times the tank, the draining, or the drying area is in operation or use. When the system is first installed, the airflow from each hood shall be measured by means of a pitot traverse in the exhaust duct and corrective action taken if the flow is less than that required. When the proper flow is obtained, the hood static pressure shall be measured and recorded. At intervals of not more than 3 months operation, or after a prolonged shutdown period, the hoods and duct system shall be inspected for evidence of corrosion or damage. In any case where the airflow is found to be less than required, it shall be increased to the required value. (Information on airflow and static pressure measurement and calculations may be found in American National Standard Fundamental Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, or in the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists.)

(ii) The exhaust system shall discharge to the outer air in such a manner that the possibility of its effluent entering any building is at a minimum. Recirculation shall only be through a device for contaminant removal which will prevent the creation of a health hazard in the room or area to which the air is recirculated.

(iii) A volume of outside air in the range of 90 percent to 110 percent of the exhaust volume shall be provided to each room having exhaust hoods. The outside air supply shall enter the workroom in such a manner as not to be detrimental to any exhaust hood. The airflow of the makeup air system shall be measured on installation. Corrective action shall be taken when the airflow is below that required. The makeup air shall be uncontaminated.

(9) Personal protection.

(i) All employees working in and around open-surface tank operations must be instructed as to the hazards of their respective jobs, and in the personal protection and first aid procedures applicable to these hazards.

(ii) All persons required to work in such a manner that their feet may become wet shall be provided

with rubber or other impervious boots or shoes, rubbers, or wooden-soled shoes sufficient to keep feet dry.

(iii) All persons required to handle work wet with a liquid other than water shall be provided with gloves impervious to such a liquid and of a length sufficient to prevent entrance of liquid into the tops of the gloves. The interior of gloves shall be kept free from corrosive or irritating contaminants.

(iv) All persons required to work in such a manner that their clothing may become wet shall be provided with such aprons, coats, jackets, sleeves, or other garments made of rubber, or of other materials impervious to liquids other than water, as are required to keep their clothing dry. Aprons shall extend well below the top of boots to prevent liquid splashing into the boots. Provision of dry, clean, cotton clothing along with rubber shoes or short boots and an apron impervious to liquids other than water shall be considered a satisfactory substitute where small parts are cleaned, plated, or acid dipped in open tanks and rapid work is required.

(v) Whenever there is a danger of splashing, for example, when additions are made manually to the tanks, or when acids and chemicals are removed from the tanks, the employees so engaged shall be required to wear either tight-fitting chemical goggles or an effective face shield. See 1926.102.

(vi) When, during the emergencies specified in paragraph (i)(11)(v) of this section, employees must be in areas where concentrations of air contaminants are greater than the limits set by paragraph (i)(2)(iii) of this section or oxygen concentrations are less than 19.5 percent, they must use respirators that reduce their exposure to a level below these limits or that provide adequate oxygen. Such respirators must also be provided in marked, quickly-accessible storage compartments built for this purpose when the possibility exists of accidental release of hazardous concentrations of air contaminants. Respirators must be approved by NIOSH under 42 CFR part 84, selected by a competent industrial hygienist or other technically-qualified source, and used in accordance with 29 CFR 1926.103.

(vii) Near each tank containing a liquid which may burn, irritate, or otherwise be harmful to the skin if splashed upon the worker's body, there shall be a supply of clean cold water. The water pipe (carrying a pressure not exceeding 25 pounds) shall be provided with a quick opening valve and at least 48 inches of hose not smaller than three-fourths inch, so that no time may be lost in washing off liquids from the skin or clothing. Alternatively, deluge showers and eye flushes shall be provided in cases where harmful chemicals may be splashed on parts of the body.

(viii) Operators with sores, burns, or other skin lesions requiring medical treatment shall not be allowed to work at their regular operations until so authorized by a physician. Any small skin abrasions, cuts, rash, or open sores which are found or reported shall be treated by a properly designated person so that chances of exposures to the chemicals are removed. Workers exposed to chromic acids shall have a periodic examination made of the nostrils and other parts of the body, to detect incipient ulceration.

(ix) Sufficient washing facilities, including soap, individual towels, and hot water, shall be provided for all persons required to use or handle any liquids which may burn, irritate, or otherwise be harmful to the skin, on the basis of at least one basin (or its equivalent) with a hot water faucet for every 10 employees. See 1926.51(f).

(x) Locker space or equivalent clothing storage facilities shall be provided to prevent contamination of street clothing.

(xi) First aid facilities specific to the hazards of the operations conducted shall be readily available.

(10) Special precautions for cyanide. Dikes or other arrangements shall be provided to prevent the possibility of intermixing of cyanide and acid in the event of tank rupture.

(11) Inspection, maintenance, and installation.

(i) Floors and platforms around tanks shall be prevented from becoming slippery both by original type of construction and by frequent flushing. They shall be firm, sound, and of the design and construction to minimize the possibility of tripping.

(ii) Before cleaning the interior of any tank, the contents shall be drained off, and the cleanout doors shall be opened where provided. All pockets in tanks or pits, where it is possible for hazardous vapors to collect, shall be ventilated and cleared of such vapors.

(iii) Tanks which have been drained to permit employees to enter for the purposes of cleaning, inspection, or maintenance may contain atmospheres which are hazardous to life or health, through the presence of flammable or toxic air contaminants, or through the absence of sufficient oxygen. Before employees shall be permitted to enter any such tank, appropriate tests of the atmosphere shall be made to determine if the limits set by paragraph (d)(2)(iii) of this section are exceeded, or if the oxygen concentration is less than 19.5 percent.

(iv) If the tests made in accordance with paragraph(d)(11)(iii) of this section indicate that the atmosphere in the tank is unsafe, before any employee is permitted to enter the tank, the tank shall be ventilated until the hazardous atmosphere is removed, and ventilation shall be continued so as to prevent the occurrence of a hazardous atmosphere as long as an employee is in the tank.

(v) If, in emergencies, such as rescue work, it is necessary to enter a tank which may contain a hazardous atmosphere, suitable respirators, such as self-contained breathing apparatus; hose mask with blower, if there is a possibility of oxygen deficiency; or a gas mask, selected and operated in accordance with paragraph (d)(9)(vi) of this section, shall be used. If a contaminant in the tank can cause dermatitis, or be absorbed through the skin, the employee entering the tank shall also wear protective clothing. At least one trained standby employee, with suitable respirator, shall be present in the nearest uncontaminated area. The standby employee must be able to communicate with the employee in the tank and be able to haul him out of the tank with a lifeline if necessary.

(vi) Maintenance work requiring welding or open flame, where toxic metal fumes such as cadmium, chromium, or lead may be evolved, shall be done only with sufficient local exhaust ventilation to prevent the creation of a health hazard, or be done with respirators selected and used in accordance with paragraph (d)(9)(vi) of this section. Welding, or the use of open flames near any solvent cleaning equipment shall be permitted only after such equipment has first been thoroughly cleared of solvents and vapors.

(12) Vapor degreasing tanks.

(i) In any vapor degreasing tank equipped with a condenser or vapor level thermostat, the condenser or thermostat shall keep the level of vapors below the top edge of the tank by a distance at least equal to one-half the tank width, or at least 36 inches, whichever is shorter.

(ii) Where gas is used as a fuel for heating vapor degreasing tanks, the combustion chamber shall be

of tight construction, except for such openings as the exhaust flue, and those that are necessary for supplying air for combustion. Flues shall be of corrosion-resistant construction and shall extend to the outer air. If mechanical exhaust is used on this flue, a draft diverter shall be used. Special precautions must be taken to prevent solvent fumes from entering the combustion air of this or any other heater when chlorinated or fluorinated hydrocarbon solvents (for example, trichloroethylene, Freon) are used.

(iii) Heating elements shall be so designed and maintained that their surface temperature will not cause the solvent or mixture to decompose, break down, or be converted into an excessive quantity of vapor.

(iv) Tanks or machines of more than 4 square feet of vapor area, used for solvent cleaning or vapor degreasing, shall be equipped with suitable cleanout or sludge doors located near the bottom of each tank or still. These doors shall be so designed and gasketed that there will be no leakage of solvent when they are closed.

(13) Scope.

(i) This paragraph (d) applies to all operations involving the immersion of materials in liquids, or in the vapors of such liquids, for the purpose of cleaning or altering their surfaces, or adding or imparting a finish thereto, or changing the character of the materials, and their subsequent removal from the liquids or vapors, draining, and drying. Such operations include washing, electroplating, anodizing, pickling, quenching, dyeing, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, digesting, and other similar operations, but do not include molten materials handling operations, or surface coating operations.

(ii) *"**Molten materials handling operations***" means all operations, other than welding, burning, and soldering operations, involving the use, melting, smelting, or pouring of metals, alloys, salts, or other similar substances in the molten state. Such operations also include heat treating baths, descaling baths, die casting stereotyping, galvanizing, tinning, and similar operations.

(iii) *"**Surface coating operations***" means all operations involving the application of protective, decorative, adhesive, or strengthening coating or impregnation to one or more surfaces, or into the interstices of any object or material, by means of spraying, spreading, flowing, brushing, roll coating, pouring, cementing, or similar means; and any subsequent draining or drying operations, excluding open-tank operations.

29 CFR 1926.59
HAZARD COMMUNICATION

Note: The requirements applicable to construction work under this section are identical to those set forth at 1910.1200 of this chapter.

29 CFR 1926.60
METHYLENEDIANILINE

(a) Scope and application.

(1) This section applies to all construction work as defined in 29 CFR 1910.12(b), in which there is exposure to MDA, including but not limited to the following:

(i) Construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof, that contain MDA;

(ii) Installation or the finishing of surfaces with products containing MDA;

(iii) MDA spill/emergency cleanup at construction sites; and

(iv) Transportation, disposal, storage, or containment of MDA or products containing MDA on the site or location at which construction activities are performed.

(2) Except as provided in paragraphs (a)(7) and (f)(5) of this section, this section does not apply to the processing, use, and handling of products containing MDA where initial monitoring indicates that the product is not capable of releasing MDA in excess of the action level under the expected conditions of processing, use, and handling which will cause the greatest possible release; and where no ``dermal exposure to MDA" can occur.

(3) Except as provided in paragraph (a)(7) of this section, this section does not apply to the processing, use, and handling of products containing MDA where objective data are reasonably relied upon which demonstrate the product is not capable of releasing MDA under the expected conditions of processing, use, and handling which will cause the greatest possible release; and where no ``dermal exposure to MDA" can occur.

(4) Except as provided in paragraph (a)(7) of this section, this section does not apply to the storage, transportation, distribution or sale of MDA in intact containers sealed in such a manner as to contain the MDA dusts, vapors, or liquids, except for the provisions of 29 CFR 1910.1200 and paragraph (e) of this section.

(5) Except as provided in paragraph (a)(7) of this section, this section does not apply to materials in any form which contain less than 0.1% MDA by weight or volume.

(6) Except as provided in paragraph (a)(7) of this section, this section does not apply to ``finished articles containing MDA."

(7) Where products containing MDA are exempted under paragraphs (a)(2) through (a)(6) of this section, the employer shall maintain records of the initial monitoring results or objective data supporting that exemption and the basis for the employer's reliance on the data, as provided in the recordkeeping provision of paragraph (o) of this section.

(b) Definitions. For the purpose of this section, the following definitions shall apply:

Action level means a concentration of airborne MDA of 5 ppb as an eight (8)-hour time-weighted average.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Authorized person means any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring and measuring procedures under paragraph (p) of this section, or any other person authorized by the Act or regulations issued under the Act.

Container means any barrel, bottle, can, cylinder, drum, reaction vessel, storage tank, commercial packaging or the like, but does not include piping systems.

Decontamination area means an area outside of but as near as practical to the regulated area, consisting of an equipment storage area, wash area, and clean change area, which is used for the decontamination of workers, materials, and equipment contaminated with MDA.

Dermal exposure to MDA occurs where employees are engaged in the handling, application or use of mixtures or materials containing MDA, with any of the following non-airborne forms of MDA:

(i) Liquid, powdered, granular, or flaked mixtures containing MDA in concentrations greater than 0.1% by weight or volume; and

(ii) Materials other than ``finished articles" containing MDA in concentrations greater than 0.1% by weight or volume.

Director means the Director of the National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which results in an unexpected and potentially hazardous release of MDA.

Employee exposure means exposure to MDA which would occur if the employee were not using respirators or protective work clothing and equipment.

Finished article containing MDA is defined as a manufactured item:

(i) Which is formed to a specific shape or design during manufacture;

(ii) Which has end use function(s) dependent in whole or part upon its shape or design during end use; and

(iii) Where applicable, is an item which is fully cured by virtue of having been subjected to the conditions (temperature, time) necessary to complete the desired chemical reaction.

Historical monitoring data means monitoring data for construction jobs that meet the following conditions:

(i) The data upon which judgments are based are scientifically sound and were collected using methods that are sufficiently accurate and precise;

(ii) The processes and work practices that were in use when the historical monitoring data were obtained are essentially the same as those to be used during the job for which initial monitoring will not be performed;

(iii) The characteristics of the MDA-containing material being handled when the historical monitoring data were obtained are the same as those on the job for which initial monitoring will not be performed;

(iv) Environmental conditions prevailing when the historical monitoring data were obtained are the same as those on the job for which initial monitoring will not be performed; and

(v) Other data relevant to the operations, materials, processing,or employee exposures covered by the exception are substantially similar. The data must be scientifically sound, the characteristics of the MDA containing material must be similar and the environmental conditions comparable.

4,4 Methylenedianiline or ***MDA*** means the chemical; 4,4-diaminodiphenylmethane, Chemical Abstract Service Registry number 101-77-9, in the form of a vapor, liquid, or solid. The definition also includes the salts of MDA.

Regulated Areas means areas where airborne concentrations of MDA exceed or can reasonably be expected to exceed, the permissible exposure limits, or where ``dermal exposure to MDA" can occur.

STEL means short term exposure limit as determined by any 15-minute sample period.

(c) Permissible exposure limits. The employer shall assure that no employee is exposed to an airborne concentration of MDA in excess of ten parts per billion (10 ppb) as an 8-hour time-weighted average and a STEL of one hundred parts per billion (100 ppb).

(d) Communication among employers. On multi-employer worksites, an employer performing work involving the application of MDA or materials containing MDA for which establishment of one or more regulated areas is required shall inform other employers on the site of the nature of the employer's work with MDA and of the existence of, and requirements pertaining to, regulated areas.

(e) Emergency situations

(1) Written plan.

(i) A written plan for emergency situations shall be developed for each construction operation where there is a possibility of an emergency. The plan shall include procedures where the employer identifies emergency escape routes for his employees at each construction site before the construction operation begins. Appropriate portions of the plan shall be implemented in the event of an emergency.

(ii) The plan shall specifically provide that employees engaged in correcting emergency conditions shall be equipped with the appropriate personal protective equipment and clothing as required in paragraphs (i) and (j) of this section until the emergency is abated.

(iii) The plan shall specifically include provisions for alerting and evacuating affected employees as well as the applicable elements prescribed in 29 CFR 1910.38, ``Employee emergency plans and fire prevention plans."

(2) Alerting employees. Where there is the possibility of employee exposure to MDA due to an emergency, means shall be developed to promptly alert employees who have the potential to be directly exposed. Affected employees not engaged in correcting emergency conditions shall be evacuated immediately in the event that an emergency occurs. Means shall also be developed for alerting other employees who may be exposed as a result of the emergency.

(f) Exposure monitoring

(1) General.

(i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of each employee's exposure to airborne MDA over an eight (8) hour period. Determination of employee exposure to the STEL shall be made from breathing zone air samples collected over a 15 minute sampling period.

(ii) Representative employee exposure shall be determined on the basis of one or more samples representing full shift exposure for each shift for each job classification in each work area where exposure to MDA may occur.

(iii) Where the employer can document that exposure levels are equivalent for similar operations in different work shifts, the employer shall only be required to determine representative employee exposure for that operation during one shift.

(2) Initial monitoring. Each employer who has a workplace or work operation covered by this standard shall perform initial monitoring to determine accurately the airborne concentrations of MDA to which employees may be exposed unless:

(i) The employer can demonstrate, on the basis of objective data, that the MDA-containing product or material being handled cannot cause exposures above the standard's action level, even under worst-case release conditions; or

(ii) The employer has historical monitoring or other data demonstrating that exposures on a particular job will be below the action level.

(3) Periodic monitoring and monitoring frequency.

(i) If the monitoring required by paragraph (f)(2) of this section reveals employee exposure at or above the action level, but at or below the PELs, the employer shall repeat such monitoring for each such employee at least every six (6) months.

(ii) If the monitoring required by paragraph (f)(2) of this section reveals employee exposure above the PELs, the employer shall repeat such monitoring for each such employee at least every three (3) months.

(iii) Employers who are conducting MDA operations within a regulated area can forego periodic monitoring if the employees are all wearing supplied-air respirators while working in the regulated area.

(iv) The employer may alter the monitoring schedule from every three months to every six months for any employee for whom two consecutive measurements taken at least 7 days apart indicate that the employee exposure has decreased to below the PELs but above the action level.

(4) Termination of monitoring.

(i) If the initial monitoring required by paragraph (f)(2) of this section reveals employee exposure to be below the action level, the employer may discontinue the monitoring for that employee, except as otherwise required by paragraph (f)(5) of this section.

(ii) If the periodic monitoring required by paragraph (f)(3) of this section reveals that employee exposures, as indicated by at least two consecutive measurements taken at least 7 days apart, are below the action level the employer may discontinue the monitoring for that employee, except as otherwise required by paragraph (f)(5) of this section.

(5) Additional monitoring. The employer shall institute the exposure monitoring required under paragraphs (f)(2) and (f)(3) of this section when there has been a change in production process, chemicals present, control equipment, personnel, or work practices which may result in new or additional exposures to MDA, or when the employer has any reason to suspect a change which may result in new or additional exposures.

(6) Accuracy of monitoring. Monitoring shall be accurate, to a confidence level of 95 percent, to within plus or minus 25 percent for airborne concentrations of MDA.

(7) Employee notification of monitoring results.

(i) The employer shall, within 15 working days after the receipt of the results of any monitoring performed under this standard, notify each employee of these results, in writing, either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) The written notification required by paragraph (f)(7)(i) of this section shall contain the corrective action being taken by the employer or any other protective measures which have been implemented to reduce the employee exposure to or below the PELs, wherever the PELs are exceeded.

(8) Visual monitoring. The employer shall make routine inspections of employee hands, face and forearms potentially exposed to MDA. Other potential dermal exposures reported by the employee must be referred to the appropriate medical personnel for observation. If the employer determines that the employee has been exposed to MDA the employer shall:

(i) Determine the source of exposure;

(ii) Implement protective measures to correct the hazard; and

(iii) Maintain records of the corrective actions in accordance with paragraph (n) of this section.

(g) Regulated areas

(1) Establishment.

(i) Airborne exposures. The employer shall establish regulated areas where airborne concentrations of MDA exceed or can reasonably be expected to exceed, the permissible exposure limits.

(ii) Dermal exposures. Where employees are subject to ``dermal exposure to MDA" the employer shall establish those work areas as regulated areas.

(2) Demarcation. Regulated areas shall be demarcated from the rest of the workplace in a manner that minimizes the number of persons potentially exposed.

(3) Access. Access to regulated areas shall be limited to authorized persons.

(4) Personal protective equipment and clothing. Each person entering a regulated area shall be supplied with, and required to use, the appropriate personal protective clothing and equipment in accordance with paragraphs (i) and (j) of this section.

(5) Prohibited activities. The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.

(h) Methods of compliance

(1) Engineering controls and work practices and respirators.

(i) The employer shall use one or any combination of the following control methods to achieve compliance with the permissible exposure limits prescribed by paragraph (c) of this section:

(A) Local exhaust ventilation equipped with HEPA filter dust collection systems;

(B) General ventilation systems;

(C) Use of workpractices; or

(D) Other engineering controls such as isolation and enclosure that the Assistant Secretary can show to be feasible.

(ii) Wherever the feasible engineering controls and work practices ``which can be instituted are not sufficient to reduce employee exposure to or below the PELs, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protective devices which comply with the requirements of paragraph (i) of this section.

(2) Special Provisions. For workers engaged in spray application methods, respiratory protection must be used in addition to feasible engineering controls and work practices to reduce employee exposure to or below the PELs.

(3) Prohibitions. Compressed air shall not be used to remove MDA, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

(4) Employee rotation. The employer shall not use employee rotation as a means of compliance with the exposure limits prescribed in paragraph (c) of this section.

(5) Compliance program.

(i) The employer shall establish and implement a written program to reduce employee exposure to or

below the PELs by means of engineering and work practice controls, as required by paragraph (h)(1) of this section, and by use of respiratory protection where permitted under this section.

(ii) Upon request this written program shall be furnished for examination and copying to the Assistant Secretary, the Director, affected employees and designated employee representatives. The employer shall review and, as necessary, update such plans at least once every 12 months to make certain they reflect the current status of the program.

(i) Respiratory protection

(1) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls.

(ii) Work operations, such as maintenance and repair activities and spray-application processes, for which engineering and work-practice controls are not feasible.

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the PELs.

(iv) Emergencies.

(2) Respirator program. The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii), and (f) through (m).

(3) Respirator selection.

(i) The employer must select the appropriate respirator from Table 1 of this section.

Table 1
Respiratory Protection for MDA

Airborne concentration of MDA or condition of use	Respirator type
a. Less than or equal to 10 x PEL.	(1) Half-Mask Respirator with HEPA\1\ Cartridge.\2\
b. Less than or equal to 50 x PEL.	(1) Full facepiece Respirator with HEPA\1\ Cartridge or Canister.\2\
c. Less than or equal to 1000 x PEL.	(1) Full facepiece powered air-purifying respirator with HEPA\1\ cartridge.\2\
d. Greater than 1000 x PEL or unknown concentration.	(1) Self-contained breathing apparatus with full facepiece in positive pressure mode. (2) Full facepiece positive pressure demand supplied-air respirator with auxiliary self-contained air supply.
e. Escape.....	(1) Any full facepiece air-purifying respirator with HEPA\1\ cartridges.\2\ (2) Any positive pressure or continuous flow self-contained breathing apparatus with full facepiece or hood.
f. Firefighting.....	(1) Full facepiece self-contained breathing apparatus in positive pressure demand mode.

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Note: Respirators assigned for higher environmental concentrations may be used
at lower concentrations.
\1\ High Efficiency Particulate in Air filter (HEPA) means a filter that is at
least 99.97 percent efficient against mono-dispersed particles of 0.3
micrometers or larger.
\2\ Combination HEPA/Organic Vapor Cartridges shall be used whenever MDA in
liquid form or a process requiring heat is used.
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(ii) An employee who cannot use a negative-pressure respirator must be given the option of using a positive-pressure respirator, or a supplied-air respirator operated in the continuous-flow or pressure-demand mode.

(j) Protective work clothing and equipment

(1) Provision and use. Where employees are subject to dermal exposure to MDA, where liquids containing MDA can be splashed into the eyes, or where airborne concentrations of MDA are in excess of the PEL, the employer shall provide, at no cost to the employee, and ensure that the employee uses, appropriate protective work clothing and equipment which prevent contact with MDA such as, but not limited to:

(i) Aprons, coveralls or other full-body work clothing;

(ii) Gloves, head coverings, and foot coverings; and

(iii) Face shields, chemical goggles; or

(iv) Other appropriate protective equipment which comply with 29 CFR 1910.133.

(2) Removal and storage.

(i) The employer shall ensure that, at the end of their work shift, employees remove MDA-contaminated protective work clothing and equipment that is not routinely removed throughout the day in change areas provided in accordance with the provisions in paragraph (k) of this section.

(ii) The employer shall ensure that, during their work shift, employees remove all other MDA-contaminated protective work clothing or equipment before leaving a regulated area.

(iii) The employer shall ensure that no employee takes MDA-contaminated work clothing or equipment out of the decontamination areas, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(iv) MDA-contaminated work clothing or equipment shall be placed and stored and transported in sealed, impermeable bags, or other closed impermeable containers.

(v) Containers of MDA-contaminated protective work clothing or equipment which are to be taken out of decontamination areas or the workplace for cleaning, maintenance, or disposal, shall bear labels warning of the hazards of MDA.

(3) Cleaning and replacement.

(i) The employer shall provide the employee with clean protective clothing and equipment. The

employer shall ensure that protective work clothing or equipment required by this paragraph is cleaned, laundered, repaired, or replaced at intervals appropriate to maintain its effectiveness.

(ii) The employer shall prohibit the removal of MDA from protective work clothing or equipment by blowing, shaking, or any methods which allow MDA to re-enter the workplace.

(iii) The employer shall ensure that laundering of MDA-contaminated clothing shall be done so as to prevent the release of MDA in the workplace.

(iv) Any employer who gives MDA-contaminated clothing to another person for laundering shall inform such person of the requirement to prevent the release of MDA.

(v) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with MDA of the potentially harmful effects of exposure.

(4) Visual Examination.

(i) The employer shall ensure that employees' work clothing is examined periodically for rips or tears that may occur during performance of work.

(ii) When rips or tears are detected, the protective equipment or clothing shall be repaired and replaced immediately.

(k) Hygiene facilities and practices

(1) General.

(i) The employer shall provide decontamination areas for employees required to work in regulated areas or required by paragraph (j)(1) of this section to wear protective clothing. Exception: In lieu of the decontamination area requirement specified in paragraph (k)(1)(i) of this section, the employer may permit employees engaged in small scale, short duration operations, to clean their protective clothing or dispose of the protective clothing before such employees leave the area where the work was performed.

(ii) Change areas. The employer shall ensure that change areas are equipped with separate storage facilities for protective clothing and street clothing, in accordance with 29 CFR 1910.141(e).

(iii) Equipment area. The equipment area shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective clothing and equipment.

(2) Shower area.

(i) Where feasible, shower facilities shall be provided which comply with 29 CFR 1910.141(d)(3) wherever the possibility of employee exposure to airborne levels of MDA in excess of the permissible exposure limit exists.

(ii) Where dermal exposure to MDA occurs, the employer shall ensure that materials spilled or deposited on the skin are removed as soon as possible by methods which do not facilitate the dermal absorption of MDA.

(3) Lunch Areas.

(i) Whenever food or beverages are consumed at the worksite and employees are exposed to MDA the employer shall provide clean lunch areas were MDA levels are below the action level and where no dermal exposure to MDA can occur.

(ii) The employer shall ensure that employees wash their hands and faces with soap and water prior to eating, drinking, smoking, or applying cosmetics.

(iii) The employer shall ensure that employees do not enter lunch facilities with contaminated protective work clothing or equipment.

(l) Communication of hazards to employees

(1) Signs and labels.

(i) The employer shall post and maintain legible signs demarcating regulated areas and entrances or accessways to regulated areas that bear the following legend:

DANGER
MDA
MAY CAUSE CANCER
LIVER TOXIN
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING MAY BE REQUIRED TO BE WORN IN THIS AREA

(ii) The employer shall ensure that labels or other appropriate forms of warning are provided for containers of MDA within the workplace. The labels shall comply with the requirements of 29 CFR 1910.1200(f) and shall include one of the following legends:

(A) For pure MDA

DANGER
CONTAINS MDA
MAY CAUSE CANCER
LIVER TOXIN

(B) For mixtures containing MDA

DANGER
CONTAINS MDA
CONTAINS MATERIALS WHICH MAY CAUSE CANCER
LIVER TOXIN

(2) Material safety data sheets (MSDS). Employers shall obtain or develop, and shall provide access to their employees, to a material safety data sheet (MSDS) for MDA.

(3) Information and training.

(i) The employer shall provide employees with information and training on MDA, in accordance with 29 CFR 1910.1200(h), at the time of initial assignment and at least annually thereafter.

(ii) In addition to the information required under 29 CFR 1910.1200, the employer shall:

(A) Provide an explanation of the contents of this section, including appendices A and B of this section, and indicate to employees where a copy of the standard is available;

(B) Describe the medical surveillance program required under paragraph (n) of this section, and explain the information contained in appendix C of this section; and

(C) Describe the medical removal provision required under paragraph (n) of this section.

(4) Access to training materials.

(i) The employer shall make readily available to all affected employees, without cost, all written materials relating to the employee training program, including a copy of this regulation.

(ii) The employer shall provide to the Assistant Secretary and the Director, upon request, all information and training materials relating to the employee information and training program.

(m) Housekeeping.

(1) All surfaces shall be maintained as free as practicable of visible accumulations of MDA.

(2) The employer shall institute a program for detecting MDA leaks, spills, and discharges, including regular visual inspections of operations involving liquid or solid MDA.

(3) All leaks shall be repaired and liquid or dust spills cleaned up promptly.

(4) Surfaces contaminated with MDA may not be cleaned by the use of compressed air.

(5) Shoveling, dry sweeping, and other methods of dry clean-up of MDA may be used where HEPA filtered vacuuming and/or wet cleaning are not feasible or practical.

(6) Waste, scrap, debris, bags, containers, equipment, and clothing contaminated with MDA shall be collected and disposed of in a manner to prevent the re-entry of MDA into the workplace.

(n) Medical surveillance

(1) General.

(2) Initial examinations.

(i) Within 150 days of the effective date of this standard, or before the time of initial assignment, the employer shall provide each employee covered by paragraph (n)(1)(i) of this section with a medical examination including the following elements:

(A) A detailed history which includes:

(1) Past work exposure to MDA or any other toxic substances;

(2) A history of drugs, alcohol, tobacco, and medication routinely taken (duration and quantity); and

(3) A history of dermatitis, chemical skin sensitization, or previous hepatic disease.

(B) A physical examination which includes all routine physical examination parameters, skin examination, and examination for signs of liver disease.

(C) Laboratory tests including:

(1) Liver function tests and

(2) Urinalysis.

(D) Additional tests as necessary in the opinion of the physician.

(ii) No initial medical examination is required if adequate records show that the employee has been examined in accordance with the requirements of this section within the previous six months prior to the effective date of this standard or prior to the date of initial assignment.

(3) Periodic examinations.

(i) The employer shall provide each employee covered by this section with a medical examination at least annually following the initial examination. These periodic examinations shall include at least the following elements:

(A) A brief history regarding any new exposure to potential liver toxins, changes in drug, tobacco, and alcohol intake, and the appearance of physical signs relating to the liver, and the skin;

(B) The appropriate tests and examinations including liver function tests and skin examinations; and

(C) Appropriate additional tests or examinations as deemed necessary by the physician.

(ii) If in the physician's opinion the results of liver function tests indicate an abnormality, the employee shall be removed from further MDA exposure in accordance with paragraph (n)(9) of this section. Repeat liver function tests shall be conducted on advice of the physician.

(4) Emergency examinations. If the employer determines that the employee has been exposed to a potentially hazardous amount of MDA in an emergency situation under paragraph (e) of this section, the employer shall provide medical examinations in accordance with paragraphs (n)(3) (i) and (ii) of this section. If the results of liver function testing indicate an abnormality, the employee shall be removed in accordance with paragraph (n)(9) of this section. Repeat liver function tests shall be conducted on the advice of the physician. If the results of the tests are normal, tests must be repeated two to three weeks from the initial testing. If the results of the second set of tests are normal and on the advice of the physician, no additional testing is required.

(5) Additional examinations. Where the employee develops signs and symptoms associated with exposure to MDA, the employer shall provide the employee with an additional medical examination including liver function tests. Repeat liver function tests shall be conducted on the advice of the physician. If the results of the tests are normal, tests must be repeated two to three weeks from the initial testing. If the results of the second set of tests are normal and on the advice of the physician, no additional testing is required.

(6) Multiple physician review mechanism.

(i) If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, and the employee has signs or symptoms of occupational exposure to MDA (which could include an abnormal liver function test), and the employee disagrees with the opinion of the examining physician, and this opinion could affect the employee's job status, the employee may designate an appropriate and mutually acceptable second physician:

(A) To review any findings, determinations or recommendations of the initial physician; and

(B) To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(ii) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

(A) The employee informing the employer that he or she intends to seek a second medical opinion, and

(B) The employee initiating steps to make an appointment with a second physician.

(iii) If the findings, determinations, or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve any disagreement.

(iv) If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

(A) To review any findings, determinations, or recommendations of the prior physicians; and

(B) To conduct such examinations, consultations, laboratory tests, and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(v) The employer shall act consistent with the findings, determinations, and recommendations of the second physician, unless the employer and the employee reach a mutually acceptable agreement.

(7) Information provided to the examining physician.

(i) The employer shall provide the following information to the examining physician:

(A) A copy of this regulation and its appendices;

(B) A description of the affected employee's duties as they relate to the employee's potential exposure to MDA;

(C) The employee's current actual or representative MDA exposure level;

(D) A description of any personal protective equipment used or to be used; and

(E) Information from previous employment related medical examinations of the affected employee.

(ii) The employer shall provide the foregoing information to a second physician under this section upon request either by the second physician, or by the employee.

(8) Physician's written opinion.

(i) For each examination under this section, the employer shall obtain, and provide the employee with a copy of, the examining physician's written opinion within 15 days of its receipt. The written opinion shall include the following:

(A) The occupationally pertinent results of the medical examination and tests;

(B) The physician's opinion concerning whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of health from exposure to MDA;

(C) The physician's recommended limitations upon the employee's exposure to MDA or upon the employee's use of protective clothing or equipment and respirators; and

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions resulting from MDA exposure which require further explanation or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

(9) Medical removal

(i) Temporary medical removal of an employee

(A) Temporary removal resulting from occupational exposure. The employee shall be removed from work environments in which exposure to MDA is at or above the action level or where dermal exposure to MDA may occur, following an initial examination (paragraph (n)(2) of this section), periodic examinations (paragraph (n)(3) of this section), an emergency situation (paragraph (n)(4) of this section), or an additional examination (paragraph (n)(5) of this section) in the following circumstances:

(1) When the employee exhibits signs and/or symptoms indicative of acute exposure to MDA; or

(2) When the examining physician determines that an employee's abnormal liver function tests are not associated with MDA exposure but that the abnormalities may be exacerbated as a result of occupational exposure to MDA.

(B) Temporary removal due to a final medical determination.

(1) The employer shall remove an employee from work having an exposure to MDA

at or above the action level or where the potential for dermal exposure exists on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to MDA.

(2) For the purposes of this section, the phrase ``final medical determination'' shall mean the outcome of the physician review mechanism used pursuant to the medical surveillance provisions of this section.

(3) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to MDA, the employer shall implement and act consistent with the recommendation.

(ii) Return of the employee to former job status.

(A) The employer shall return an employee to his or her former job status:

(1) When the employee no longer shows signs or symptoms of exposure to MDA, or upon the advice of the physician.

(2) When a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to MDA.

(B) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(iii) Removal of other employee special protective measure or limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(iv) Employer options pending a final medical determination. Where the physician review mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(A) Removal. The employer may remove the employee from exposure to MDA, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of the physician who has reviewed the employee's health status.

(B) Return. The employer may return the employee to his or her former job status, and end any special protective measures provided to the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, with two exceptions:

(1) If the initial removal, special protection, or limitation of the employee resulted

from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician; or

(2) The employee has been on removal status for the preceding six months as a result of exposure to MDA, then the employer shall await a final medical determination.

(v) Medical removal protection benefits

(A) Provisions of medical removal protection benefits. The employer shall provide to an employee up to six (6) months of medical removal protection benefits on each occasion that an employee is removed from exposure to MDA or otherwise limited pursuant to this section.

(B) Definition of medical removal protection benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that the employer shall maintain the earnings, seniority, and other employment rights and benefits of an employee as though the employee had not been removed from normal exposure to MDA or otherwise limited.

(C) Follow-up medical surveillance during the period of employee removal or limitations. During the period of time that an employee is removed from normal exposure to MDA or otherwise limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(D) Workers' compensation claims. If a removed employee files a claim for workers' compensation payments for a MDA-related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment-related expenses.

(E) Other credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or receives income from employment with any employer made possible by virtue of the employee's removal.

(F) Employees who do not recover within the 6 months of removal. The employer shall take the following measures with respect to any employee removed from exposure to MDA:

(1) The employer shall make available to the employee a medical examination pursuant to this section to obtain a final medical determination with respect to the employee;

(2) The employer shall assure that the final medical determination obtained indicates whether or not the employee may be returned to his or her former job status, and, if not, what steps should be taken to protect the employee's health;

(3) Where the final medical determination has not yet been obtained, or once obtained indicates that the employee may not yet be returned to his or her former job status, the employer shall continue to provide medical removal protection benefits to the employee until either the employee is returned to former job status, or a final medical determination is made that the employee is incapable of ever safely returning to his or her former job status; and

(4) Where the employer acts pursuant to a final medical determination which permits the return of the employee to his or her former job status despite what would otherwise be an unacceptable liver function test, later questions concerning removing the employee again shall be decided by a final medical determination. The employer need not automatically remove such an employee pursuant to the MDA removal criteria provided by this section.

(vi) Voluntary removal or restriction of an employee. Where an employer, although not required by this section to do so, removes an employee from exposure to MDA or otherwise places limitations on an employee due to the effects of MDA exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to that required by paragraph (n)(9)(v) of this section.

(o) Recordkeeping

(1) Objective data for exempted operations.

(i) Where the employer has relied on objective data that demonstrate that products made from or containing MDA are not capable of releasing MDA or do not present a dermal exposure problem under the expected conditions of processing, use, or handling to exempt such operations from the initial monitoring requirements under paragraph (f)(2) of this section, the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(ii) The record shall include at least the following information:

(A) The product qualifying for exemption;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and/or analysis of the material for the release of MDA;
(D) A description of the operation exempted and how the data support the exemption; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(2) Historical monitoring data.

(i) Where the employer has relied on historical monitoring data that demonstrate that exposures on a particular job will be below the action level to exempt such operations from the initial monitoring requirements under paragraph (f)(2) of this section, the employer shall establish and maintain an

accurate record of historical monitoring data reasonably relied upon in support of the exception.

(ii) The record shall include information that reflect the following conditions:

(A) The data upon which judgments are based are scientifically sound and were collected using methods that are sufficiently accurate and precise;

(B) The processes and work practices that were in use when the historical monitoring data were obtained are essentially the same as those to be used during the job for which initial monitoring will not be performed;

(C) The characteristics of the MDA-containing material being handled when the historical monitoring data were obtained are the same as those on the job for which initial monitoring will not be performed;

(D) Environmental conditions prevailing when the historical monitoring data were obtained are the same as those on the job for which initial monitoring will not be performed; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exception.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such historical monitoring data.

(3) The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.

(4) Exposure measurements.

(i) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to MDA.

(ii) This record shall include at least the following information:

(A) The date of measurement;

(B) The operation involving exposure to MDA;

(C) Sampling and analytical methods used and evidence of their accuracy;

(D) Number, duration, and results of samples taken;

(E) Type of protective devices worn, if any; and

(F) Name, social security number, and exposure of the employees whose exposures are represented.

(iii) The employer shall maintain this record for at least thirty (30) years, in accordance with 29 CFR 1910.20.

(5) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by paragraph (n) of this section, in accordance with 29 CFR 1910.20.

(ii) The record shall include at least the following information:

(A) The name and social security number of the employee;

(B) A copy of the employee's medical examination results, including the medical history, questionnaire responses, results of any tests, and physician's recommendations.

(C) Physician's written opinions;

(D) Any employee medical complaints related to exposure to MDA; and

(E) A copy of the information provided to the physician as required by paragraph (n) of this section.

(iii) The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with 29 CFR 1910.20.

(iv) A copy of the employee's medical removal and return to work status.

(6) Training records. The employer shall maintain all employee training records for one (1) year beyond the last date of employment.

(7) Availability.

(i) The employer, upon written request, shall make all records required to be maintained by this section available to the Assistant Secretary and the Director for examination and copying.

(ii) The employer, upon request, shall make any exposure records required by paragraphs (f) and (n) of this section available for examination and copying to affected employees, former employees, designated representatives, and the Assistant Secretary, in accordance with 29 CFR 1910.20(a)-(e) and (g)-(i).

(iii) The employer, upon request, shall make employee medical records required by paragraphs (n) and (o) of this section available for examination and copying to the subject employee, anyone having the specific written consent of the subject employee, and the Assistant Secretary, in accordance with 29 CFR 1910.20.

(8) Transfer of records.

(i) The employer shall comply with the requirements concerning transfer of records set forth in 29 CFR 1910.20(h).

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the Director at least 90 days prior to disposal and, upon request, transmit them to the Director.

(p) Observation of monitoring

(1) Employee observation. The employer shall provide affected employees, or their designated representatives, an opportunity to observe the measuring or monitoring of employee exposure to MDA conducted pursuant to paragraph (f) of this section.

(2) Observation procedures. When observation of the measuring or monitoring of employee exposure to MDA requires entry into areas where the use of protective clothing and equipment or respirators is required, the employer shall provide the observer with personal protective clothing and equipment or respirators required to be worn by employees working in the area, assure the use of such clothing and equipment or respirators, and require the observer to comply with all other applicable safety and health procedures.

(q) Effective date. This standard shall become effective on September 9, 1992.

(r) Appendices. The information contained in appendices A, B, C and D of this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation. The protocols for respiratory fit testing in appendix E of this section are mandatory.

(s) Startup dates. Compliance with all obligations of this standard commence September 9, 1992, except as follows:

(1) Initial monitoring under paragraph (f)(2) of this section shall be completed as soon as possible but no later than December 8, 1992.

(2) Medical examinations under paragraph (n) of this section shall be completed as soon as possible but no later than February 8, 1993.

(3) Emergency plans required by paragraph (e) of this section shall be provided and available for inspection and copying as soon as possible but no later than January 7, 1993.

(4) Initial training and education shall be completed as soon as possible but no later than January 7, 1993.

(5) Decontamination and lunch areas under paragraph (k) of this section shall be in operation as soon as possible but no later than September 9, 1993.

(6) Respiratory Protection required by paragraph (i) of this section shall be provided as soon as possible but no later than January 7, 1993.

(7) Written compliance plans required by paragraph (h)(5) of this section shall be completed and available for inspection and copying as soon as possible but no later than January 7, 1993.

(8) OSHA shall enforce the permissible exposure limits in paragraph (c) of this section no earlier than January 7, 1993.

(9) Engineering controls needed to achieve the PELs must be in place September 9, 1993.

(10) Personal protective clothing required by paragraph (j) of this section shall be available January 7, 1993.

Appendix A

Substance Data Sheet, for 4-4'-Methylenedianiline

Note: The requirements applicable to construction work under this Appendix A are identical to those set forth in Appendix A to 1910.1050 of this chapter.

Appendix B
Substance Technical Guidelines, MDA

Note: The requirements applicable to construction work under this Appendix B are identical to those set forth in Appendix B to 1910.1050 of this chapter.

Appendix C
Medical Surveillance Guidelines for MDA

Note: The requirements applicable to construction work under this Appendix C are identical to those set forth in Appendix C to 1910.1050 of this chapter.

Appendix D
Sampling and Analytical Methods for MDA Monitoring and Measurement Procedures

Note: The requirements applicable to construction work under this Appendix D are identical to those set forth in Appendix D to 1910.1050 of this chapter.

29 CFR 1926.61
RETENTION OF DOT MARKINGS, PLACARDS & LABELS

Note: The requirements applicable to construction work under this section are identical to those set forth in 1910.1201 of this chapter.

29 CFR 1926.62
LEAD

(a) Scope. This section applies to all construction work where an employee may be occupationally exposed to lead. All construction work excluded from coverage in the general industry standard for lead by 29 CFR 1910.1025(a)(2) is covered by this standard. Construction work is defined as work for construction, alteration and/or repair, including painting and decorating. It includes but is not limited to the following:

(1) Demolition or salvage of structures where lead or materials containing lead are present;

(2) Removal or encapsulation of materials containing lead;

(3) New construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead;

(4) Installation of products containing lead;

(5) Lead contamination/emergency cleanup;

(6) Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed, and

(7) Maintenance operations associated with the construction activities described in this paragraph.

(b) Definitions.

*"**Action level**"* means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 ug/m(3)) calculated as an 8-hour time-weighted average (TWA).

*"**Assistant Secretary**"* means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

*"**Competent person**"* means one who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.

*"**Director**"* means the Director, National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, or designee.

*"**Lead**"* means metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

*"**This section**"* means this standard.

(c) Permissible exposure limit.

(1) The employer shall assure that no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air (50 ug/m(3)) averaged over an 8-hour period.

(2) If an employee is exposed to lead for more than 8 hours in any work day the employees' allowable exposure, as a time weighted average (TWA) for that day, shall be reduced according to the following formula: Allowable employee exposure (in ug/m(3)) = 400 divided by hours worked in the day.

(3) When respirators are used to limit employee exposure as required under paragraph (c) of this section and all the requirements of paragraphs (e)(1) and (f) of this section have been met, employee exposure may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.

(d) Exposure assessment -

(1) General.

(i) Each employer who has a workplace or operation covered by this standard shall initially determine if any employee may be exposed to lead at or above the action level.

(ii) For the purposes of paragraph (d) of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(iii) With the exception of monitoring under paragraph (d)(3), where monitoring is required under this section, the employer shall collect personal samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure level.

(iv)Full shift personal samples shall be representative of the monitored employee's regular, daily exposure to lead.

(2) Protection of employees during assessment of exposure.

(i) With respect to the lead related tasks listed in this paragraph (d)(2)(i) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph (d) of this section and documents that the employee performing any of the listed tasks is not exposed above the PEL, the employer shall treat the employee as if the employee were exposed above the PEL, and not in excess of ten (10) times the PEL, and shall implement employee protective measures prescribed in paragraph (d)(2)(v) of this section. The tasks covered by this requirement are:

(A) Where lead containing coatings or paint are present: Manual demolition of structures (e.g, dry wall), manual scraping, manual sanding, heat gun applications, and power tool cleaning with dust collection systems;

(B) Spray painting with lead paint

(ii) In addition, with regard to tasks not listed in paragraph (d)(2)(i), where the employer has any reason to believe that an employee performing the task may be exposed to lead in excess of the PEL, until the employer performs an employee exposure assessment as required by paragraph (d) of this section and documents that the employee's lead exposure is not above the PEL the employer shall treat the employee as if the employee were exposed above the PEL and shall implement employee protective measures as prescribed in paragraph (d)(2)(v) of this section.

(iii) With respect to the tasks listed in this paragraph (d)(2)(iii) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph (d) of this section, and documents that the employee performing any of the listed tasks is not exposed in excess of 500 ug/m(3), the employer shall treat the employee as if the employee were exposed to lead in excess of 500 ug/m(3) and shall implement employee protective measures as prescribed in paragraph (d)(2)(v) of this section. Where the employer does establish that the employee is exposed to levels of lead below 500 ug/m(3), the employer may provide the exposed employee with the appropriate respirator prescribed for such use at such lower exposures, in accordance with Table 1 of this section. The taskscovered by this requirement are:

(A) Using lead containing mortar; lead burning

(B) Where lead containing coatings or paint are present: rivet busting; power tool cleaning without dust collection systems; cleanup activities where dry expendable abrasives are used; and abrasive blasting enclosure movement and removal.

(iv) With respect to the tasks listed in this paragraph (d)(2)(iv) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph (d) of this section and documents that the employee performing any of the listed tasks is not exposed to lead in excess of 2,500 ug/m(3) (50 x PEL), the employer shall treat the employee as if the employee were exposed to lead in excess of 2,500 ug/m(3) and shall implement employee protective measures as prescribed in paragraph (d)(2)(v) of this section. Where the employer does establish that the employee is exposed to levels of lead below 2,500 ug/m(3), the employer may provide the exposed employee with the appropriate respirator prescribed for use at such lower exposures, in accordance with Table I of this section. Interim protection as described in this paragraph is required where lead containing coatings or paint are present on structures when performing:

(A) Abrasive blasting,

(B) Welding,

(C) Cutting, and

(D) Torch burning.

(v) Until the employer performs an employee exposure assessment as required under paragraph (d) of this section and determines actual employee exposure, the employer shall provide to employees performing the tasks described in paragraphs (d)(2)(i), (d)(2)(ii), (d)(2)(iii) and (d)(2)(iv) of this section with interim protection as follows:

(A) Appropriate respiratory protection in accordance with paragraph (f) of this section.

(B) Appropriate personal protective clothing and equipment in accordance with paragraph (g) of this section.

(C) Change areas in accordance with paragraph (i)(2) of this section.

(D) Hand washing facilities in accordance with paragraph (i)(5) of this section.

(E) Biological monitoring in accordance with paragraph (j)(1)(i) of this section, to consist of blood sampling and analysis for lead and zinc protoporphyrin levels, and(d)(2)(v)(F)

Training as required under paragraph (l)(1)(i) of this section regarding 29 CFR 1926.59, Hazard Communication; training as required under paragraph (l)(2)(ii)(C) of this section, regarding use of respirators; and training in accordance with 29 CFR 1926.21, Safety training and education.

(3) Basis of initial determination.

(i) Except as provided under paragraphs (d)(3)(iii) and (d)(3)(iv) of this section the employer shall monitor employee exposures and shall base initial determinations on the employee exposure monitoring results and any of the following, relevant considerations:

(A) Any information, observations, or calculations which would indicate employee exposure to lead;

(B) Any previous measurements of airborne lead; and

(C) Any employee complaints of symptoms which may be attributable to exposure to lead.

(ii) Monitoring for the initial determination where performed may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest airborne concentrations of lead in the workplace

(iii) Where the employer has previously monitored for lead exposures, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraphs (d)(3)(i) and (d)(6) of this section if the sampling and analytical methods meet the accuracy and confidence levels of paragraph (d)(10) of this section.

(iv) Where the employer has objective data, demonstrating that a particular product or material containing lead or a specific process, operation or activity involving lead cannot result in employee exposure to lead at or above the action level during processing, use, or handling, the employer may rely upon such data instead of implementing initial monitoring.

(A) The employer shall establish and maintain an accurate record documenting the nature and relevancy of objective data as specified in paragraph (n)(4) of this section, where used in assessing employee exposure in lieu of exposure monitoring.

(B) Objective data, as described in this paragraph (d)(3)(iv) of this section, is not permitted to be used for exposure assessment in connection with paragraph (d)(2) of this section.

(4) Positive initial determination and initial monitoring.

(i) Where a determination conducted under paragraphs (d)(1), (2) and (3) of this section shows the possibility of any employee exposure at or above the action level the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.

(ii) Where the employer has previously monitored for lead exposure, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely

resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (d)(4)(i) of this section if the sampling and analytical methods meet the accuracy and confidence levels of paragraph (d)(10) of this section.

(5) Negative initial determination. Where a determination, conducted under paragraphs (d)(1), (2), and (3) of this section is made that no employee is exposed to airborne concentrations of lead at or above the action level the employer shall make a written record of such determination. The record shall include at least the information specified in paragraph (d)(3)(i) of this section and shall also include the date of determination, location within the worksite, and the name and social security number of each employee monitored.

(6) Frequency.

(i) If the initial determination reveals employee exposure to be below the action level further exposure determination need not be repeated except as otherwise provided in paragraph (d)(7) of this section.

(ii) If the initial determination or subsequent determination reveals employee exposure to be at or above the action level but at or below the PEL the employer shall perform monitoring in accordance with this paragraph at least every 6 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in paragraph (d)(7) of this section.

(iii) If the initial determination reveals that employee exposure is above the PEL the employer shall perform monitoring quarterly. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are at or below the PEL but at or above the action level at which time the employer shall repeat monitoring for that employee at the frequency specified in paragraph (d)(6)(ii) of this section, except as otherwise provided in paragraph (d)(7) of this section. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in paragraph (d)(7) of this section.

(7) Additional exposure assessments. Whenever there has been a change of equipment, process, control, personnel or a new task has been initiated that may result in additional employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL, the employer shall conduct additional monitoring in accordance with this paragraph.

(8) Employee notification.

(i) Within 5 working days after completion of the exposure assessment the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure, without regard to respirators, is at or above the PEL the employer shall include in the written notice a statement that the employees exposure was at or above that level and a description of the corrective action taken or to be taken to reduce exposure to below that level.

(9) Accuracy of measurement. The employer shall use a method of monitoring and analysis which has an

accuracy (to a confidence level of 95 percent) of not less than plus or minus 25 percent for airborne concentrations of lead equal to or greater than 30 ug/m(3).

(e) Methods of compliance

(1) Engineering and work practice controls. The employer shall implement engineering and work practice controls,administrative controls, to reduce and maintain employee exposure to lead to or below the permissible exposure limit to the extent that such controls are feasible. Wherever all feasible engineering and work practices controls that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit prescribed in paragraph (c) of this section, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph (f) of this section.

(2) Compliance program.

(i) Prior to commencement of the job each employer shall establish and implement a written compliance program to achieve compliance with paragraph (c) of this section.

(ii) Written plans for these compliance programs shall include at least the following:

(A) A description of each activity in which lead is emitted; e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices;

(B) A description of the specific means that will be employed to achieve compliance and, where engineering controls are required engineering plans and studies used to determine methods selected for controlling exposure to lead;

(C) A report of the technology considered in meeting the PEL;

(D) Air monitoring data which documents the source of lead emissions;

(E) A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;

(F) A work practice program which includes items required under paragraphs (g), (h) and (i) of this section and other relevant work practices such as those specified in paragraph (e)(5) of this section;

(G) An administrative control schedule required by paragraph (e)(4) of this section, if applicable;

(H) A description of arrangements made among contractors on multi-contractor sites with respect to informing affected employees of potential exposure to lead and with respect to responsibility for compliance with this section as set-forth in 1926.16.

(I) Other relevant information.

(iii) The compliance program shall provide for frequent and regular inspections of job sites, materials, and equipment to be made by a competent person.

(iv) Written programs shall be submitted upon request to any affected employee or authorized employee representatives, to Assistant Secretary and the Director, and shall be available at the worksite for examination and copying by the Assistant Secretary and the Director.

(v) Written programs shall be revised and updated at least every 6 months to reflect the current status of the program.

(3) Mechanical ventilation. When ventilation is used to control lead exposure, the employer shall evaluate the mechanical performance of the system in controlling exposure as necessary to maintain its effectiveness.

(4) Administrative controls. If administrative controls are used as a means of reducing employees TWA exposure to lead, the employer shall establish and implement a job rotation schedule which includes:

(i) Name or identification number of each affected employee;

(ii) Duration and exposure levels at each job or work station where each affected employee is located; and

(iii) Any other information which may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

(5) The employer shall ensure that, to the extent relevant, employees follow good work practices such as described in Appendix B of this section.

(f) Respiratory protection.

(1) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this paragraph. Respirators must be used during:

(i) Periods when an employee's exposure to lead exceeds the PEL.

(ii) Work operations for which engineering and work-practice controls are not sufficient to reduce employee exposures to or below the PEL.

(iii) Periods when an employee requests a respirator.

(iv) Periods when respirators are required to provide interim protection of employees while they perform the operations specified in paragraph (d)(2) of this section.

(2) Respirator program.

(i) The employer must implement a respiratory protection program in accordance with 29 CFR 1910.134 (b) through (d) (except (d)(1)(iii)), and (f) through (m).

(ii) If an employee has breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination in accordance with paragraph (j)(3)(i)(B) of this section to determine whether or not the employee can use a respirator while performing the required duty.

(3) Respirator selection.

(i) The employer must select the appropriate respirator or combination of respirators from Table I of this section.

(ii) The employer must provide a powered air-purifying respirator when an employee chooses to use such a respirator and it will provide adequate protection to the employee.

(g) Protective work clothing and equipment -

(1) Provision and use. Where an employee is exposed to lead above the PEL without regard to the use of respirators, where employees are exposed to lead compounds which may cause skin or eye irritation (e.g. lead arsenate, lead azide), and as interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, the employer shall provide at no cost to the employee and assure that the employee uses appropriate protective work clothing and equipment that prevents contamination of the employee and the employee's garments such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, hats, and shoes or disposable shoe coverlets; and

(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with 1910.133 of this chapter.

(2) Cleaning and replacement.

(i) The employer shall provide the protective clothing required in paragraph (g)(1) of this section in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to a respirator are over 200 ug/m(3) of lead as an 8-hour TWA.

(ii) The employer shall provide for the cleaning, laundering, and disposal of protective clothing and equipment required by paragraph (g)(1) of this section.

(iii) The employer shall repair or replace required protective clothing and equipment as needed to maintain their effectiveness.

(iv) The employer shall assure that all protective clothing is removed at the completion of a work shift only in change areas provided for that purpose as prescribed in paragraph (i)(2) of this section.

(v) The employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change area which prevents dispersion of lead outside the container.

(vi) The employer shall inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to lead.

(vii) The employer shall assure that the containers of contaminated protective clothing and equipment required by paragraph (g)(2)(v) of this section are labelled as follows:

Caution: Clothing contaminated with lead. Do not remove dust by blowing or shaking. Dispose of lead contaminated wash water in accordance with applicable local, state, or federal regulations.

(viii) The employer shall prohibit the removal of lead from protective clothing or equipment by blowing, shaking, or any other means which disperses lead into the air.

(h) Housekeeping -

(1) All surfaces shall be maintained as free as practicable of accumulations of lead.

(2) Clean-up of floors and other surfaces where lead accumulates shall wherever possible, be cleaned by vacuuming or other methods that minimize the likelihood of lead becoming airborne.

(3) Shoveling, dry or wet sweeping, and brushing may be used only where vacuuming or other equally effective methods have been tried and found not to be effective.

(4) Where vacuuming methods are selected, the vacuums shall be equipped with HEPA filters and used and emptied in a manner which minimizes the reentry of lead into the workplace.

(5) Compressed air shall not be used to remove lead from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.

(i) Hygiene facilities and practices.

(1) The employer shall assure that in areas where employees are exposed to lead above the PEL without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.

(2) Change areas.

(i) The employer shall provide clean change areas for employees whose airborne exposure to lead is above the PEL, andas interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, without regard to the use of respirators.

(ii) The employer shall assure that change areas are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross - contamination.

(iii) The employer shall assure that employees do not leave the workplace wearing any protective clothing or equipment that is required to be worn during the work shift.

(3) Showers.

(i) The employer shall provide shower facilities, where feasible, for use by employees whose airborne exposure to lead is above the PEL.

(ii) The employer shall assure, where shower facilities are available, that employees shower at the end of the work shift and shall provide an adequate supply of cleansing agents and towels for use by affected employees.

(4) Eating facilities.

(i) The employer shall provide lunchroom facilities or eating areas for employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators.

(ii) The employer shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination and are readily accessible to employees.

(iii) The employer shall assure that employees whose airborne exposure to lead is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.

(iv) The employer shall assure that employees do not enter lunchroom facilities or eating areas with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method that limits dispersion of lead dust.

(5) Hand Washing facilities.

(i) The employer shall provide adequate handwashing facilities for use by employees exposed to lead in accordance with 29 CFR 1926.51(f).

(ii) Where showers are not provided the employer shall assure that employees wash their hands and face at the end of the work - shift.

(j) Medical surveillance -

(1) General.

(i) The employer shall make available initial medical surveillance to employees occupationally exposed on any day to lead at or above the action level. Initial medical surveillance consists of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels.

(ii) The employer shall institute a medical surveillance program in accordance with paragraphs (j)(2) and (j)(3) of this section for all employees who are or may be exposed by the employer at or above the action level for more than 30 days in any consecutive 12 months;

(iii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

(iv) The employer shall make available the required medical surveillance including multiple physician review under paragraph (j)(3)(iii) without cost to employees and at a reasonable time and place.

(2) Biological monitoring -

(i) Blood lead and ZPP level sampling and analysis". The employer shall make available biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels to each employee covered under paragraphs (j)(1)(i) and (ii) of this section on the following schedule:

(A) For each employee covered under paragraph (j)(1)(ii) of this section, at least every 2 months for the first 6 months and every 6 months thereafter;

(B) For each employee covered under paragraphs (j)(1)(i) or (ii) of this section whose last blood sampling and analysis indicated a blood lead level at or above 40 ug/dl, at least every two months. This frequency shall continue until two consecutive blood samples and analyses indicate a blood lead level below 40 ug/dl; and

(C) For each employee who is removed from exposure to lead due to an elevated blood lead level at least monthly during the removal period.

(ii) Follow-up blood sampling tests. Whenever the results of a blood lead level test indicate that an employee's blood lead level exceeds the numerical criterion for medical removal under paragraph (k)(1)(i) of this section, the employer provide a second (follow-up) blood sampling test within two weeks after the employer receives the results of the first blood sampling test.

(iii) Accuracy of blood lead level sampling and analysis. Blood lead level sampling and analysis provided pursuant to this section shall have an accuracy (to a confidence level of 95 percent) within plus or minus 15 percent or 6 ug/dl, whichever is greater, and shall be conducted by a laboratory approved by OSHA.

(iv) Employee notification.

(A) Within five working days after the receipt of biological monitoring results, the employer shall notify each employee in writing of his or her blood lead level; and

(B) the employer shall notify each employee whose blood lead level exceeds 40 ug/dl that the standard requires temporary medical removal with Medical Removal Protection benefits when an employee's blood lead level exceeds the numerical criterion for medical removal under paragraph (k)(1)(i) of this section.

(3) Medical examinations and consultations -

(i) Frequency. The employer shall make available medical examinations and consultations to each employee covered under paragraph (j)(1)(ii) of this section on the following schedule:

(A) At least annually for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 ug/dl;

(B) As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, that the employee is pregnant, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during use; and

(C) As medically appropriate for each employee either removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited pursuant to a final medical determination.

(ii) Content. The content of medical examinations made available pursuant to paragraph (j)(3)(i)(B) - (C) of this section shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility. Medical examinations made available pursuant to paragraph (j)(3)(i)(A) of this section shall include the following elements:

(A) A detailed work history and a medical history, with particular attention to past lead exposure (occupational and non-occupational), personal habits (smoking, hygiene), and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems;

(B) A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used;

(C) A blood pressure measurement;

(D) A blood sample and analysis which determines:

(1) Blood lead level;

(2) Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology;

(3) Zinc protoporphyrin;

(4) Blood urea nitrogen; and,

(5) Serum creatinine;

(E) A routine urinalysis with microscopic examination; and

(F) Any laboratory or other test relevant to lead exposure which the examining physician deems necessary by sound medical practice.

(iii) Multiple physician review mechanism.

(A) If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, the employee may designate a second physician:

(1) To review any findings, determinations or recommendations of the initial physician; and

(2) To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(B) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

(1) The employee informing the employer that he or she intends to seek a second medical opinion, and

(2) The employee initiating steps to make an appointment with a second physician.

(C) If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve any disagreement.

(D) If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

(1) To review any findings, determinations or recommendations of the prior physicians; and

(2) To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(E) The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(iv) Information provided to examining and consulting physicians.

(A) The employer shall provide an initial physician conducting a medical examination or consultation under this section with the following information:

(1) A copy of this regulation for lead including all Appendices;

(2) A description of the affected employee's duties as they relate to the employee's exposure;

(3) The employee's exposure level or anticipated exposure level to lead and to any other toxic substance (if applicable);

(4) A description of any personal protective equipment used or to be used;

(5) Prior blood lead determinations; and

(6) All prior written medical opinions concerning the employee in the employer's possession or control.

(B) The employer shall provide the foregoing information to a second or third physician conducting a medical examination or consultation under this section upon request either by the second or third physician, or by the employee.

(v) Written medical opinions.

(A) The employer shall obtain and furnish the employee with a copy of a written medical opinion from each examining or consulting physician which contains only the following information:

(1) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to lead;

(2) Any recommended special protective measures to be provided to the employee,

or limitations to be placed upon the exposure to lead;

(3) Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air purifying respirator if a physician determines that the employee cannot wear a negative pressure respirator; and

(4) The results of the blood lead determinations.

(B) The employer shall instruct each examining and consulting physician to:

(1) Not reveal either in the written opinion or orally, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to an employee's occupational exposure to lead; and

(2) Advise the employee of any medical condition, occupational or nonoccupational, which dictates further medical examination or treatment.

(vi) Alternate physician determination mechanisms. The employer and an employee or authorized employee representative may agree upon the use of any alternate physician determination mechanism in lieu of the multiple physician review mechanism provided by paragraph (j)(3)(iii) of this section so long as the alternate mechanism is as expeditious and protective as the requirements contained in this paragraph.

(4) Chelation.

(i) The employer shall assure that any person whom he retains, employs, supervises or controls does not engage in prophylactic chelation of any employee at any time.

(ii) If therapeutic or diagnostic chelation is to be performed by any person in paragraph (j)(4)(i) of this section, the employer shall assure that it be done under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring and that the employee is notified in writing prior to its occurrence.

(k) Medical removal protection -

(1) Temporary medical removal and return of an employee -

(i) Temporary removal due to elevated blood lead level. The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a periodic and a follow-up blood sampling test conducted pursuant to this section indicate that the employee's blood lead level is at or above 50 ug/dl; and,

(ii) Temporary removal due to a final medical determination.

(A) The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the phrase "final medical determination" means the written medical opinion on the employees' health status by the examining physician or, where relevant, the outcome of the multiple physician review mechanism or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section.

(C) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to lead, the employer shall implement and act consistent with the recommendation.

(iii) Return of the employee to former job status.

(A) The employer shall return an employee to his or her former job status:

(1) For an employee removed due to a blood lead level at or above 50 ug/dl when two consecutive blood sampling tests indicate that the employee's blood lead level is at or below 40 ug/dl;

(2) For an employee removed due to a final medical determination, when a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(iv) Removal of other employee special protective measure or limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures no longer necessary.

(v) Employer options pending a final medical determination. Where the multiple physician review mechanism, or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(A) Removal. The employer may remove the employee from exposure to lead, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

(B) Return. The employer may return the employee to his or her former job status, end any special protective measures provided to the employee, and remove any limitations placed upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, with two exceptions.

(1) If the initial removal, special protection, or limitation of the employee resulted

from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician or;

(2) If the employee has been on removal status for the preceding eighteen months due to an elevated blood lead level, then the employer shall await a final medical determination.

(2) Medical removal protection benefits -

(i) Provision of medical removal protection benefits. The employer shall provide an employee up to eighteen (18) months of medical removal protection benefits on each occasion that an employee is removed from exposure to lead or otherwise limited pursuant to this section.

(ii) Definition of medical removal protection benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that, as long as the job the employee was removed from continues, the employer shall maintain the total normal earnings, seniority and other employment rights and benefits of an employee, including the employee's right to his or her former job status as though the employee had not been medically removed from the employee's job or otherwise medically limited.

(iii) Follow-up medical surveillance during the period of employee removal or limitation. During the period of time that an employee is medically removed from his or her job or otherwise medically limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(iv) Workers' compensation claims. If a removed employee files a claim for workers' compensation payments for a lead - related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment - related expenses.

(v) Other credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer - funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(vi) Voluntary removal or restriction of an employee. Where an employer, although not required by this section to do so, removes an employee from exposure to lead or otherwise places limitations on an employee due to the effects of lead exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to that required by paragraph (k)(2)(i) and (ii) of this section.

(l) Employee information and training -

(1) General

(i) The employer shall communicate information concerning lead hazards according to the requirements of OSHA's Hazard Communication Standard for the construction industry, 29 CFR 1926.59, including but not limited to the requirements concerning warning signs and labels, material

safety data sheets (MSDS), and employee information and training. In addition, employers shall comply with the following requirements:

(ii) For all employees who are subject to exposure to lead at or above the action level on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation (e.g. lead arsenate, lead azide), the employer shall provide a training program in accordance with paragraph (l)(2) of this section and assure employee participation.

(iii) The employer shall provide the training program as initial training prior to the time of job assignment or prior to the start up date for this requirement, whichever comes last.

(iv) The employer shall also provide the training program at least annually for each employee who is subject to lead exposure at or above the action level on any day.

(2) Training program. The employer shall assure that each employee is trained in the following:

(i) The content of this standard and its appendices;

(ii) The specific nature of the operations which could result in exposure to lead above the action level;

(iii) The purpose, proper selection, fitting, use, and limitations of respirators;

(iv) The purpose and a description of the medical surveillance program, and the medical removal protection program including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females and hazards to the fetus and additional precautions for employees who are pregnant);

(v) The engineering controls and work practices associated with the employee's job assignment including training of employees to follow relevant good work practices described in Appendix B of this section;

(vi) The contents of any compliance plan in effect;

(vii) Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician; and
(viii) The employee's right of access to records under 29 CFR 1910.20.

(3) Access to information and training materials.

(i) The employer shall make readily available to all affected employees a copy of this standard and its appendices.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to affected employees and their designated representatives, and to the Assistant Secretary and the Director.

(m) Signs -

(1) General.

(i) The employer may use signs required by other statutes, regulations or ordinances in addition to, or in combination with, signs required by this paragraph.

(ii) The employer shall assure that no statement appears on or near any sign required by this paragraph which contradicts or detracts from the meaning of the required sign.

(2) Signs.

(i) The employer shall post the following warning signs in each work area where an employees exposure to lead is above the PEL.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

(ii) The employer shall assure that signs required by this paragraph are illuminated and cleaned as necessary so that the legend is readily visible.

(n) Recordkeeping -

(1) Exposure assessment.

(i) The employer shall establish and maintain an accurate record of all monitoring and other data used in conducting employee exposure assessments as required in paragraph (d) of this section.

(ii) Exposure monitoring records shall include:

(A) The date(s), number, duration, location and results of each of the samples taken if any, including a description of the sampling procedure used to determine representative employee exposure where applicable;

(B) A description of the sampling and analytical methods used and evidence of their accuracy;

(C) The type of respiratory protective devices worn, if any;

(D) Name, social security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent; and

(E) The environmental variables that could affect the measurement of employee exposure.

(iii) The employer shall maintain monitoring and other exposure assessment records in accordance with the provisions of 29 CFR 1910.20.

(2) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by paragraph (j) of this section.

(ii) This record shall include:

(A) The name, social security number, and description of the duties of the employee;

(B) A copy of the physician's written opinions;

(C) Results of any airborne exposure monitoring done on or for that employee and provided to the physician; and

(D) Any employee medical complaints related to exposure to lead.

(iii) The employer shall keep, or assure that the examining physician keeps, the following medical records:

(A) A copy of the medical examination results including medical and work history required under paragraph (j) of this section;

(B) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information;

(C) A copy of the results of biological monitoring.

(iv) The employer shall maintain or assure that the physician maintains medical records in accordance with the provisions of 29 CFR 1910.20.

(3) Medical removals.

(i) The employer shall establish and maintain an accurate record for each employee removed from current exposure to lead pursuant to paragraph (k) of this section.

(ii) Each record shall include:

(A) The name and social security number of the employee;

(B) The date of each occasion that the employee was removed from current exposure to lead as well as the corresponding date on which the employee was returned to his or her former job status;

(C) A brief explanation of how each removal was or is being accomplished; and

(D) A statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level.

(iii) The employer shall maintain each medical removal record for at least the duration of an employee's employment.

(4) Objective data for exemption from requirement for initial monitoring.

(i) For purposes of this section, objective data are information demonstrating that a particular product or material containing lead or a specific process, operation, or activity involving lead cannot release dust or fumes in concentrations at or above the action level under any expected conditions of

use. Objective data can be obtained from an industry - wide study or from laboratory product test results from manufacturers of lead containing products or materials. The data the employer uses from an industry - wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices and environmental conditions in the employer's current operations.

(ii) The employer shall maintain the record of the objective data relied upon for at least 30 years.

(5) Availability. The employer shall make available upon request all records required to be maintained by paragraph (n) of this section to affected employees, former employees, and their designated representatives, and to the Assistant Secretary and the Director for examination and copying.

(6) Transfer of records.

(i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by paragraph (n) of this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to the Director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the Director at least 3 months prior to the disposal of such records and shall transmit those records to the Director if requested within the period.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in 29 CFR 1910.20(h).

(o) Observation of monitoring.

(1) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead conducted pursuant to paragraph (d) of this section.

(2) Observation procedures.

(i) Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the employer shall provide the observer with and assure the use of such respirators, clothing and equipment, and shall require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring, observers shall be entitled to:

(A) Receive an explanation of the measurement procedures;

(B) Observe all steps related to the monitoring of lead performed at the place of exposure; and

(C) Record the results obtained or receive copies of the results when returned by the laboratory.

(p) Effective date. This standard (1926.62) shall become effective June 3, 1993.

(q) Appendices. The information contained in the appendices to this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

(r) Startup dates.
(1) The requirements of paragraphs (c) through (o) of this section, including administrative controls and feasible work practice controls, but not including engineering controls specified in paragraph (e)(1) of this section, shall be complied with as soon as possible, but no later than 60 days from the effective date of this section.

(2) Feasible engineering controls specified by paragraph (e)(1) of this section shall be implemented as soon as possible, but no later than 120 days from the effective date of this section.

Appendix A
Substance Data Sheet for Occupational Exposure to Lead

I. SUBSTANCE IDENTIFICATION

A. "Substance": Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. "Compounds Covered by the Standard": The word "lead" when used in this interim final standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. "Uses": Exposure to lead occurs in several different occupations in the construction industry, including demolition or salvage of structures where lead or lead - containing materials are present; removal or encapsulation of lead - containing materials, new construction, alteration, repair, or renovation of structures that contain lead or materials containing lead; installation of products containing lead. In addition, there are construction related activities where exposure to lead may occur, including transportation, disposal, storage, or containment of lead or materials containing lead on construction sites, and maintenance operations associated with construction activities.

D. "Permissible Exposure": The permissible exposure limit (PEL) set by the standard is 50 micrograms of lead per cubic meter of air (50 ug/m(3)), averaged over an 8-hour workday.

E. "Action Level": The interim final standard establishes an action level of 30 micrograms of lead per cubic meter of air (30 ug/m(3)), averaged over an 8-hour workday. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, and training.

II. HEALTH HAZARD DATA

A. "Ways in which lead enters your body". When absorbed into your body in certain doses, lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed. Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not absorbed through your skin. When lead is scattered in the air as a dust, fume, or mist it can be

inhaled and absorbed through you lungs and upper respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion. A significant portion of the lead that you inhale or ingest gets into your blood stream. Once in your blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

B. "Effects of overexposure to lead" -

(1) "Short term (acute) overexposure". Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from cardiorespiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

(2) "Long-term (chronic) overexposure". Chronic overexposure to lead may result in severe damage to your blood - forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain. Damage to the central nervous system in general and the brain (encephalopathy) in particular is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy. Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible. Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women.

The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood. Overexposure to lead also disrupts the blood - forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

(3) "Health protection goals of the standard". Prevention of adverse health effects for most workers from exposure to lead throughout a working lifetime requires that a worker's blood lead level (BLL, also expressed as PbB) be maintained at or below forty micrograms per deciliter of whole blood (40 ug/dl). The blood lead levels of workers (both male and female workers) who intend to have children should be maintained below 30 ug/dl to minimize adverse reproductive health effects to the parents and to the developing fetus. The measurement of your blood lead level (BLL) is the most useful indicator of the amount of lead being absorbed by your body. Blood lead levels are most often reported in units of milligrams (mg) or micrograms (ug) of lead (1 mg=1000 ug) per 100 grams (100g), 100 milliliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometime BLLs are expressed in the form of mg percent or ug percent. This is a shorthand notation for 100g, 100 ml, or dl. (References to BLL measurements in this standard are expressed in the form of ug/dl.)

BLL measurements show the amount of lead circulating in your blood stream, but do not give any information about the amount of lead stored in your various tissues. BLL measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead - related diseases, however, has focused heavily on associations between BLLs and various diseases. As a result, your BLL is an important indicator of the likelihood that you will gradually acquire a lead - related health impairment or disease.

Once your blood lead level climbs above 40 ug/dl, your risk of disease increases. There is a wide variability of individual response to lead, thus it is difficult to say that a particular BLL in a given person will cause a particular effect. Studies have associated fatal encephalopathy with BLLs as low as 150 ug/dl. Other studies have shown other forms of diseases in some workers with BLLs well below 80 ug/dl. Your BLL is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have had elevated BLLs. The longer you have an elevated BLL, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage. The best way to prevent all forms of lead - related impairments and diseases -- both short term and long term -- is to maintain your BLL below 40 ug/dl. The provisions of the standard are designed with this end in mind.

Your employer has prime responsibility to assure that the provisions of the standard are complied with both by the company and by individual workers. You, as a worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing his or her actions.

(4) "Reporting signs and symptoms of health problems". You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead or your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases, your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place. The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if your employer selected the initial physician.

Appendix B
Employee Standard Summary

This appendix summarizes key provisions of the interim final standard for lead in construction that you as a worker should become familiar with.

I. Permissible Exposure Limit (PEL) - Paragraph (C)

The standard sets a permissible exposure limit (PEL) of 50 micrograms of lead per cubic meter of air (50 ug/m(3)), averaged over an 8-hour workday which is referred to as a time-weighted average (TWA). This is the highest level of lead in air to which you may be permissibly exposed over an 8-hour workday. However, since this is an 8-hour average, short exposures above the PEL are permitted so long as for each 8-hour work day your average exposure does not exceed this level. This interim final standard, however, takes into account the fact that your daily exposure to lead can extend beyond a typical 8-hour workday as the result of overtime or other alterations in your work schedule. To deal with this situation, the standard contains a formula which reduces your permissible exposure when you are exposed more than 8 hours. For example, if you are exposed to lead for 10 hours a day, the maximum permitted average exposure would be 40 ug/m(3).

II. Exposure Assessment - Paragraph (D)

If lead is present in your workplace in any quantity, your employer is required to make an initial determination of whether any employee's exposure to lead exceeds the action level (30 ug/m(3) averaged over an 8-hour day). Employee exposure is that exposure which would occur if the employee were not using a respirator. This initial determination requires your employer to monitor workers' exposures unless he or she has objective data which can demonstrate conclusively that no employee will be exposed to lead in excess of the action level. Where objective data is used in lieu of actual monitoring the employer must establish and maintain an accurate record, documenting its relevancy in assessing exposure levels for current job conditions. If such objective data is available, the employer need proceed no further on employee exposure assessment until such time that conditions have changed and the determination is no longer valid.

Objective date may be compiled from various sources, e.g., insurance companies and trade associations and information from suppliers or exposure data collected from similar operations. Objective data may also comprise previously - collected sampling data including area monitoring. If it cannot be determined through using objective data that worker exposure is less than the action level, your employer must conduct monitoring or must rely on relevant previous personal sampling, if available. Where monitoring is required for the initial determination, it may be limited to a number of employees who are reasonably expected to have the highest exposure levels. If your employer has conducted appropriate air sampling for lead in the past 12 months, he or she may use these results, provided they are applicable to the same

employee tasks and exposure conditions and meet the requirements for accuracy as specified in the standard. As with objective data, if such results are relied upon for the initial determination, your employer must establish and maintain a record as to the relevancy of such data to current job conditions.

If there have been any employee complaints of symptoms which may be attributable to exposure to lead or if there is any other information or observations which would indicate employee exposure to lead, this must also be considered as of the initial determination.

If this initial determination shows that a reasonable possibility exists that any employee may be exposed, without regard to respirators, over the action level, your employer must set up an air monitoring program to determine the exposure level representative of each employee exposed to lead at your workplace. In carrying out this air monitoring program, your employer is not required to monitor the exposure of every employee, but he or she must monitor a representative number of employees and job types. Enough sampling must be done to enable each employee's exposure level to be reasonably represent full shift exposure. In addition, these air samples must be taken under conditions which represent each employee's regular, daily exposure to lead. Sampling performed in the past 12 months may be used to determine exposures above the action level if such sampling was conducted during work activities essentially similar to present work conditions.

The standard lists certain tasks which may likely result in exposures to lead in excess of the PEL and, in some cases, exposures in excess of 50 times the PEL. If you are performing any of these tasks, your employer must provide you with appropriate respiratory protection, protective clothing and equipment, change areas, hand washing facilities, biological monitoring, and training until such time that an exposure assessment is conducted which demonstrates that your exposure level is below the PEL.

If you are exposed to lead and air sampling is performed, your employer is required to notify you in writing within 5 working days of the air monitoring results which represent your exposure. If the results indicate that your exposure exceeds the PEL (without regard to your use of a respirator), then your employer must also notify you of this in writing, and provide you with a description of the corrective action that has been taken or will be taken to reduce your exposure.

Your exposure must be rechecked by monitoring, at least every six months if your exposure is at or over the action level but below the PEL. Your employer may discontinue monitoring for you if 2 consecutive measurements, taken at least 7 days apart, are at or below the action level. Air monitoring must be repeated every 3 months if you are exposed over the PEL. Your employer must continue monitoring for you at this frequency until 2 consecutive measurements, taken at least 7 days apart, are below the PEL but above the action level, at which time your employer must repeat monitoring of your exposure every six months and may discontinue monitoring only after your exposure drops to or below the action level. However, whenever there is a change of equipment, process, control, or personnel or a new type of job is added at your workplace which may result in new or additional exposure to lead, your employer must perform additional monitoring.

III. Methods of Compliance - Paragraph (E)

Your employer is required to assure that no employee is exposed to lead in excess of the PEL as an 8-hour TWA. The interim final standard for lead in construction requires employers to institute engineering and work practice controls including administrative controls to the extent feasible to reduce employee exposure to lead. Where such controls are feasible but not adequate to reduce exposures below the PEL they must be used nonetheless to reduce exposures to the lowest level that can be accomplished by these means and then supplemented with appropriate respiratory protection.

Your employer is required to develop and implement a written compliance program prior to the

commencement of any job where employee exposures may reach the PEL as an 8-hour TWA. The interim final standard identifies the various that must be included in the plan. For example, employers are required to include a description of operations in which lead is emitted, detailing other relevant information about the operation such as the type of equipment used, the type of material involved, employee job responsibilities, operating procedures and maintenance practices. In addition, your employer's compliance plan must specify the means that will be used to achieve compliance and, where engineering controls are required, include any engineering plans or studies that have been used to select the control methods. If administrative controls involving job rotation are used to reduce employee exposure to lead, the job rotation schedule must be included in the compliance plan. The plan must also detail the type of protective clothing and equipment, including respirators, housekeeping and hygiene practices that will be used to protect you from the adverse effects of exposure to lead.

The written compliance program must be made available, upon request, to affected employees and their designated representatives, the Assistant Secretary and the Director.

Finally, the plan must be reviewed and updated at least every 6 months to assure it reflects the current status in exposure control.

IV. Respiratory Protection - Paragraph (F)

Your employer is required to provide and assure your use of respirators when your exposure to lead is not controlled below the PEL by other means. The employer must pay the cost of the respirator. Whenever you request one, your employer is also required to provide you a respirator even if your air exposure level is not above the PEL. You might desire a respirator when, for example, you have received medical advice that your lead absorption should be decreased. Or, you may intend to have children in the near future, and want to reduce the level of lead in your body to minimize adverse reproductive effects. While respirators are the least satisfactory means of controlling your exposure, they are capable of providing significant protection if properly chosen, fitted, worn, cleaned, maintained, and replaced when they stop providing adequate protection.

Your employer is required to select respirators from the types listed in Table I of the Respiratory Protection section of the standard (Sec. 1926.62 (f)). Any respirator chosen must be approved by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84. This respirator selection table will enable your employer to choose a type of respirator that will give you a proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your workplace. For example, a powered air-purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge, or canister to clean the air, and a power source that continuously blows filtered air into your breathing zone. Your employer might make a PAPR available to you to ease the burden of having to wear a respirator for long periods of time. The standard provides that you can obtain a PAPR upon request.

Your employer must also start a Respiratory Protection Program. This program must include written procedures for the proper selection, use, cleaning, storage, and maintenance of respirators.

Your employer must ensure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical to your protection from airborne lead. Obtaining a proper fit on each employee may require your employer to make available several different types of respirator masks. To ensure that your respirator fits properly and that facepiece leakage is minimal, your employer must give you either a qualitative or quantitative fit test as specified in Appendix A of the Respiratory Protection standard located at

29 CFR 1910.134.

You must also receive from your employer proper training in the use of respirators. Your employer is required to teach you how to wear a respirator, to know why it is needed, and to understand its limitations.

Your employer must test the effectiveness of your negative pressure respirator initially and at least every six months thereafter with a "qualitative fit test." In this test, the fit of the facepiece is checked by seeing if you can smell a substance placed outside the respirator. If you can, there is appreciable leakage where the facepiece meets your face.

The standard provides that if your respirator uses filter elements, you must be given an opportunity to change the filter elements whenever an increase in breathing resistance is detected. You also must be permitted to periodically leave your work area to wash your face and respirator facepiece whenever necessary to prevent skin irritation. If you ever have difficulty in breathing during a fit test or while using a respirator, your employer must make a medical examination available to you to determine whether you can safely wear a respirator. The result of this examination may be to give you a positive pressure respirator (which reduces breathing resistance) or to provide alternative means of protection.

V. Protective Work Clothing and Equipment - Paragraph (G)

If you are exposed to lead above the PEL as an 8-hour TWA, without regard to your use of a respirator, or if you are exposed to lead compounds such as lead arsenate or lead azide which can cause skin and eye irritation, your employer must provide you with protective work clothing and equipment appropriate for the hazard. If work clothing is provided, it must be provided in a clean and dry condition at least weekly, and daily if your airborne exposure to lead is greater than 200 ug/m(3). Appropriate protective work clothing and equipment can include coveralls or similar full-body work clothing, gloves, hats, shoes or disposable shoe coverlets, and face shields or vented goggles. Your employer is required to provide all such equipment at no cost to you. In addition, your employer is responsible for providing repairs and replacement as necessary, and also is responsible for the cleaning, laundering or disposal of protective clothing and equipment.

The interim final standard requires that your employer assure that you follow good work practices when you are working in areas where your exposure to lead may exceed the PEL. With respect to protective clothing and equipment, where appropriate, the following procedures should be observed prior to beginning work:

1. Change into work clothing and shoe covers in the clean section of the designated changing areas;

2. Use work garments of appropriate protective gear, including respirators before entering the work area; and

3. Store any clothing not worn under protective clothing in the designated changing area.

Workers should follow these procedures upon leaving the work area:

1. HEPA vacuum heavily contaminated protective work clothing while it is still being worn. At no time may lead be removed from protective clothing by any means which result in uncontrolled dispersal of lead into the air;

2. Remove shoe covers and leave them in the work area;

3. Remove protective clothing and gear in the dirty area of the designated changing area. Remove

protective coveralls by carefully rolling down the garment to reduce exposure to dust.

4. Remove respirators last; and

5. Wash hands and face.

Workers should follow these procedures upon finishing work for the day (in addition to procedures described above):

1. Where applicable, place disposal coveralls and shoe covers with the abatement waste;
2. Contaminated clothing which is to be cleaned, laundered or disposed of must be placed in closed containers in the change room.

3. Clean protective gear, including respirators, according to standard procedures;

4. Wash hands and face again. If showers are available, take a shower and wash hair. If shower facilities are not available at the work site, shower immediately at home and wash hair.

VI. Housekeeping - Paragraph (H)

Your employer must establish a housekeeping program sufficient to maintain all surfaces as free as practicable of accumulations of lead dust. Vacuuming is the preferred method of meeting this requirement, and the use of compressed air to clean floors and other surfaces is generally prohibited unless removal with compressed air is done in conjunction with ventilation systems designed to contain dispersal of the lead dust. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other equally effective methods have been tried and do not work. Vacuums must be used equipped with a special filter called a high-efficiency particulate air (HEPA) filter and emptied in a manner which minimizes the reentry of lead into the workplace.

VII. Hygiene Facilities and Practices - Paragraph (I)

The standard requires that hand washing facilities be provided where occupational exposure to lead occurs. In addition, change areas, showers (where feasible), and lunchrooms or eating areas are to be made available to workers exposed to lead above the PEL. Your employer must assure that except in these facilities, food and beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, where airborne exposures are above the PEL. Change rooms provided by your employer must be equipped with separate storage facilities for your protective clothing and equipment and street clothes to avoid cross-contamination. After showering, no required protective clothing or equipment worn during the shift may be worn home. It is important that contaminated clothing or equipment be removed in change areas and not be worn home or you will extend your exposure and expose your family since lead from your clothing can accumulate in your house, car, etc.

Lunchrooms or eating areas may not be entered with protective clothing or equipment unless surface dust has been removed by vacuuming, downdraft booth, or other cleaning method. Finally, workers exposed above the PEL must wash both their hands and faces prior to eating, drinking, smoking or applying cosmetics.

All of the facilities and hygiene practices just discussed are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes, or your possessions. Strict compliance with these provisions can virtually eliminate several sources of lead exposure which significantly contribute to excessive lead absorption.

VIII. Medical surveillance - Paragraph (J)

The medical surveillance program is part of the standard's comprehensive approach to the prevention of lead-related disease. Its purpose is to supplement the main thrust of the standard which is aimed at minimizing airborne concentrations of lead and sources of ingestion. Only medical surveillance can determine if the other provisions of the standard have effectively protected you as an individual. Compliance with the standard's provision will protect most workers from the adverse effects of lead exposure, but may not be satisfactory to protect individual workers (1) who have high body burdens of lead acquired over past years, (2) who have additional uncontrolled sources of non-occupational lead exposure, (3) who exhibit unusual variations in lead absorption rates, or (4) who have specific non-work related medical conditions which could be aggravated by lead exposure (e.g., renal disease, anemia). In addition, control systems may fail, or hygiene and respirator programs may be inadequate. Periodic medical surveillance of individual workers will help detect those failures. Medical surveillance will also be important to protect your reproductive ability - regardless of whether you are a man or woman.

All medical surveillance required by the interim final standard must be performed by or under the supervision of a licensed physician. The employer must provide required medical surveillance without cost to employees and at a reasonable time and place. The standard's medical surveillance program has two parts -- periodic biological monitoring and medical examinations. Your employer's obligation to offer you medical surveillance is triggered by the results of the air monitoring program. Full medical surveillance must be made available to all employees who are or may be exposed to lead in excess of the action level for more than 30 days a year and whose blood lead level exceeds 40 ug/dl. Initial medical surveillance consisting of blood sampling and analysis for lead and zinc protoporphyrin must be provided to all employees exposed at any time (1 day) above the action level.

Biological monitoring under the standard must be provided at least every 2 months for the first 6 months and every 6 months thereafter until your blood lead level is below 40 ug/dl. A zinc protoporphyrin (ZPP) test is a very useful blood test which measures an adverse metabolic effect of lead on your body and is therefore an indicator of lead toxicity.

If your BLL exceeds 40 ug/dl the monitoring frequency must be increased from every 6 months to at least every 2 months and not reduced until two consecutive BLLs indicate a blood lead level below 40 ug/dl. Each time your BLL is determined to be over 40 ug/dl, your employer must notify you of this in writing within five working days of his or her receipt of the test results. The employer must also inform you that the standard requires temporary medical removal with economic protection when your BLL exceeds 50 ug/dl. (See Discussion of Medical Removal Protection - Paragraph (k).) Anytime your BLL exceeds 50 ug/dl your employer must make available to you within two weeks of receipt of these test results a second follow-up BLL test to confirm your BLL. If the two tests both exceed 50 ug/dl, and you are temporarily removed, then your employer must make successive BLL tests available to you on a monthly basis during the period of your removal.

Medical examinations beyond the initial one must be made available on an annual basis if your blood lead level exceeds 40 ug/dl at any time during the preceding year and you are being exposed above the airborne action level of 30 ug/m(3) for 30 or more days per year. The initial examination will provide information to establish a baseline to which subsequent data can be compared.

An initial medical examination to consist of blood sampling and analysis for lead and zinc protoporphyrin must also be made available (prior to assignment) for each employee being assigned for the first time to an area where the airborne concentration of lead equals or exceeds the action level at any time. In addition, a medical examination or consultation must be made available as soon as possible if you notify your

employer that you are experiencing signs or symptoms commonly associated with lead poisoning or that you have difficulty breathing while wearing a respirator or during a respirator fit test. You must also be provided a medical examination or consultation if you notify your employer that you desire medical advice concerning the effects of current or past exposure to lead on your ability to procreate a healthy child.

Finally, appropriate follow-up medical examinations or consultations may also be provided for employees who have been temporarily removed from exposure under the medical removal protection provisions of the standard. (See Part IX, below.)

The standard specifies the minimum content of pre-assignment and annual medical examinations. The content of other types of medical examinations and consultations is left up to the sound discretion of the examining physician. Pre-assignment and annual medical examinations must include (1) a detailed work history and medical history; (2) a thorough physical examination, including an evaluation of your pulmonary status if you will be required to use a respirator; (3) a blood pressure measurement; and (4) a series of laboratory tests designed to check your blood chemistry and your kidney function. In addition, at any time upon your request, a laboratory evaluation of male fertility will be made (microscopic examination of a sperm sample), or a pregnancy test will be given.

The standard does not require that you participate in any of the medical procedures, tests, etc. which your employer is required to make available to you. Medical surveillance can, however, play a very important role in protecting your health. You are strongly encouraged, therefore, to participate in a meaningful fashion. The standard contains a multiple physician review mechanism which will give you a chance to have a physician of your choice directly participate in the medical surveillance program. If you are dissatisfied with an examination by a physician chosen by your employer, you can select a second physician to conduct an independent analysis. The two doctors would attempt to resolve any differences of opinion, and select a third physician to resolve any firm dispute. Generally your employer will choose the physician who conducts medical surveillance under the lead standard - unless you and your employer can agree on the choice of a physician or physicians. Some companies and unions have agreed in advance, for example, to use certain independent medical laboratories or panels of physicians. Any of these arrangements are acceptable so long as required medical surveillance is made available to workers.

The standard requires your employer to provide certain information to a physician to aid in his or her examination of you. This information includes (1) the standard and its appendices, (2) a description of your duties as they relate to occupational lead exposure, (3) your exposure level or anticipated exposure level, (4) a description of any personal protective equipment you wear, (5) prior blood lead level results, and (6) prior written medical opinions concerning you that the employer has. After a medical examination or consultation the physician must prepare a written report which must contain (1) the physician's opinion as to whether you have any medical condition which places you at increased risk of material impairment to health from exposure to lead, (2) any recommended special protective measures to be provided to you, (3) any blood lead level determinations, and (4) any recommended limitation on your use of respirators. This last element must include a determination of whether you can wear a powered air purifying respirator (PAPR) if you are found unable to wear a negative pressure respirator.

The medical surveillance program of the interim lead standard may at some point in time serve to notify certain workers that they have acquired a disease or other adverse medical condition as a result of occupational lead exposure. If this is true, these workers might have legal rights to compensation from public agencies, their employers, firms that supply hazardous products to their employers, or other persons. Some states have laws, including worker compensation laws, that disallow a worker who learns of a job - related health impairment to sue, unless the worker sues within a short period of time after learning of the impairment. (This period of time may be a matter of months or years.) An attorney can be consulted about these possibilities. It should be stressed that OSHA is in no way trying to either encourage or discourage

claims or lawsuits. However, since results of the standard's medical surveillance program can significantly affect the legal remedies of a worker who has acquired a job - related disease or impairment, it is proper for OSHA to make you aware of this.

The medical surveillance section of the standard also contains provisions dealing with chelation. Chelation is the use of certain drugs (administered in pill form or injected into the body) to reduce the amount of lead absorbed in body tissues. Experience accumulated by the medical and scientific communities has largely confirmed the effectiveness of this type of therapy for the treatment of very severe lead poisoning. On the other hand, it has also been established that there can be a long list of extremely harmful side effects associated with the use of chelating agents. The medical community has balanced the advantages and disadvantages resulting from the use of chelating agents in various circumstances and has established when the use of these agents is acceptable. The standard includes these accepted limitations due to a history of abuse of chelation therapy by some lead companies. The most widely used chelating agents are calcium disodium EDTA, (Ca Na2 EDTA), Calcium Disodium Versenate (Versenate), and d-penicillamine (penicillamine or Cupramine).

The standard prohibits "prophylactic chelation" of any employee by any person the employer retains, supervises or controls. "Prophylactic chelation" is the routine use of chelating or similarly acting drugs to prevent elevated blood levels in workers who are occupationally exposed to lead, or the use of these drugs to routinely lower blood lead levels to predesignated concentrations believed to be "safe". It should be emphasized that where an employer takes a worker who has no symptoms of lead poisoning and has chelation carried out by a physician (either inside or outside of a hospital) solely to reduce the worker's blood lead level, that will generally be considered prophylactic chelation. The use of a hospital and a physician does not mean that prophylactic chelation is not being performed. Routine chelation to prevent increased or reduce current blood lead levels is unacceptable whatever the setting.

The standard allows the use of "therapeutic" or "diagnostic" chelation if administered under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring. Therapeutic chelation responds to severe lead poisoning where there are marked symptoms. Diagnostic chelation involved giving a patient a dose of the drug then collecting all urine excreted for some period of time as an aid to the diagnosis of lead poisoning.

In cases where the examining physician determines that chelation is appropriate, you must be notified in writing of this fact before such treatment. This will inform you of a potentially harmful treatment, and allow you to obtain a second opinion.

IX. Medical Removal Protection - Paragraph (K)

Excessive lead absorption subjects you to increased risk of disease. Medical removal protection (MRP) is a means of protecting you when, for whatever reasons, other methods, such as engineering controls, work practices, and respirators, have failed to provide the protection you need. MRP involves the temporary removal of a worker from his or her regular job to a place of significantly lower exposure without any loss of earnings, seniority, or other employment rights or benefits. The purpose of this program is to cease further lead absorption and allow your body to naturally excrete lead which has previously been absorbed. Temporary medical removal can result from an elevated blood lead level, or a medical opinion. For up to 18 months, or for as long as the job the employee was removed from lasts, protection is provided as a result of either form of removal. The vast majority of removed workers, however, will return to their former jobs long before this eighteen month period expires.

You may also be removed from exposure even if your blood lead level is below 50 ug/dl if a final medical determination indicates that you temporarily need reduced lead exposure for medical reasons. If the physician who is implementing your employers medical program makes a final written opinion recommending

your removal or other special protective measures, your employer must implement the physician's recommendation. If you are removed in this manner, you may only be returned when the doctor indicates that it is safe for you to do so.

The standard does not give specific instructions dealing with what an employer must do with a removed worker. Your job assignment upon removal is a matter for you, your employer and your union (if any) to work out consistent with existing procedures for job assignments. Each removal must be accomplished in a manner consistent with existing collective bargaining relationships. Your employer is given broad discretion to implement temporary removals so long as no attempt is made to override existing agreements. Similarly, a removed worker is provided no right to veto an employer's choice which satisfies the standard.

In most cases, employers will likely transfer removed employees to other jobs with sufficiently low lead exposure. Alternatively, a worker's hours may be reduced so that the time weighted average exposure is reduced, or he or she may be temporarily laid off if no other alternative is feasible.

In all of these situation, MRP benefits must be provided during the period of removal - i.e., you continue to receive the same earnings, seniority, and other rights and benefits you would have had if you had not been removed. Earnings includes more than just your base wage; it includes overtime, shift differentials, incentives, and other compensation you would have earned if you had not been removed. During the period of removal you must also be provided with appropriate follow-up medical surveillance. If you were removed because your blood lead level was too high, you must be provided with a monthly blood test. If a medical opinion caused your removal, you must be provided medical tests or examinations that the doctor believes to be appropriate. If you do not participate in this follow up medical surveillance, you may lose your eligibility for MRP benefits.

When you are medically eligible to return to your former job, your employer must return you to your "former job status." This means that you are entitled to the position, wages, benefits, etc., you would have had if you had not been removed. If you would still be in your old job if no removal had occurred that is where you go back. If not, you are returned consistent with whatever job assignment discretion your employer would have had if no removal had occurred. MRP only seeks to maintain your rights, not expand them or diminish them.

If you are removed under MRP and you are also eligible for worker compensation or other compensation for lost wages, your employer's MRP benefits obligation is reduced by the amount that you actually receive from these other sources. This is also true if you obtain other employment during the time you are laid off with MRP benefits.

The standard also covers situations where an employer voluntarily removes a worker from exposure to lead due to the effects of lead on the employee's medical condition, even though the standard does not require removal. In these situations MRP benefits must still be provided as though the standard required removal. Finally, it is important to note that in all cases where removal is required, respirators cannot be used as a substitute. Respirators may be used before removal becomes necessary, but not as an alternative to a transfer to a low exposure job, or to a lay-off with MRP benefits.

X. Employee Information and Training - Paragraph (L)

Your employer is required to provide an information and training program for all employees exposed to lead above the action level or who may suffer skin or eye irritation from lead compounds such as lead arsenate or lead azide. The program must train these employees regarding the specific hazards associated with their work environment, protective measures which can be taken, including the contents of any compliance plan in effect, the danger of lead to their bodies (including their reproductive systems), and their rights under

the standard. All employees must be trained prior to initial assignment to areas where there is a possibility of exposure over the action level.

This training program must also be provided at least annually thereafter unless further exposure above the action level will not occur.

XI. Signs - Paragraph (M)

The standard requires that the following warning sign be posted in work areas where the exposure to lead exceeds the PEL:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

These signs are to be posted and maintained in a manner which assures that the legend is readily visible.

XII. Recordkeeping - Paragraph (N)

Your employer is required to keep all records of exposure monitoring for airborne lead. These records must include the name and job classification of employees measured, details of the sampling and analytical techniques, the results of this , and the type of respiratory protection being worn by the person sampled. Such records are to be retained for at least 30 years. Your employer is also required to keep all records of biological monitoring and medical examination results. These records must include the names of the employees, the physician's written opinion, and a copy of the results of the examination. Medical records must be preserved and maintained for the duration of employment plus 30 years. However, if the employee's duration of employment is less than one year, the employer need not retain that employee's medical records beyond the period of employment if they are provided to the employee upon termination of employment.

Recordkeeping is also required if you are temporarily removed from your job under the medical removal protection . This record must include your name and social security number, the date of your removal and return, how the removal was or is being accomplished, and whether or not the reason for the removal was an elevated blood lead level. Your employer is required to keep each medical removal record only for as long as the duration of an employee's employment.

The standard requires that if you request to see or copy environmental monitoring, blood lead level monitoring, or medical removal records, they must be made available to you or to a representative that you authorize. Your union also has access to these records. Medical records other than BLL's must also be provided upon request to you, to your physician or to any other person whom you may specifically designate. Your union does not have access to your personal medical records unless you authorize their access.

XIII. Observation of Monitoring - Paragraph (O)

When air monitoring for lead is performed at your workplace as required by this standard, your employer must allow you or someone you designate to act as an observer of the monitoring. Observers are entitled to an explanation of the measurement procedure, and to record the results obtained. Since results will not normally be available at the time of the monitoring, observers are entitled to record or receive the results of the monitoring when returned by the laboratory. Your employer is required to provide the observer with any personal protective devices required to be worn by employees working in the area that is being monitored.

The employer must require the observer to wear all such equipment and to comply with all other applicable safety and health procedures.

XIV. Effective Date - Paragraph (P)

The standard's effective data is June 3, 1993. Employer obligations under the standard begin as of that date with full implementation of engineering controls as soon as possible but no later than within 4 months, and all other provisions completed as soon as possible, but no later than within 2 months from the effective date.

XV. For Additional Information

A. A copy of the interim standard for lead in construction can be obtained free of charge by calling or writing the OSHA Office of Publications, room N-3101, United States Department of Labor, Washington, D.C. 20210: Telephone (202) 219-4667.

B. Additional information about the standard, its enforcement, and your employer's compliance can be obtained from the nearest OSHA Area Office listed in your telephone directory under United States Government/Department of Labor.

Appendix C
Medical Surveillance Guidelines

Introduction

The primary purpose of the Occupational Safety and Health Act of 1970 is to assure, so far as possible, safe and healthful working conditions for every working man and woman. The interim final occupational health standard for lead in construction is designed to protect workers exposed to inorganic lead including metallic lead, all inorganic lead compounds and organic lead soaps.

Under this interim final standard occupational exposure to inorganic lead is to be limited to 50 ug/m(3) (micrograms per cubic meter) based on an 8 hour time-weighted average (TWA). This permissible exposure limit (PEL) must be achieved through a combination of engineering, work practice and administrative controls to the extent feasible. Where these controls are in place but are found not to reduce employee exposures to or below the PEL, they must be used nonetheless, and supplemented with respirators to meet the 50 ug/m(3) exposure limit.

The standard also provides for a program of biological monitoring for employees exposed to lead above the action at any time, and additional medical surveillance for all employees exposed to levels of inorganic lead above 30 ug/m(3) (TWA) for more than 30 days per year and whose BLL exceeds 40 ug/dl.

The purpose of this document is to outline the medical surveillance provisions of the interim standard for inorganic lead in construction, and to provide further information to the physician regarding the examination and evaluation of workers to inorganic lead.

Section 1 provides a detailed description of the monitoring procedure including the required frequency of blood testing for exposed workers, provisions for medical removal protection (MRP), the recommended right of the employee to a second medical opinion, and notification and recordkeeping requirements of the employer. A discussion of the requirements for respirator use and respirator monitoring and OSHA's position on prophylactic chelation therapy are also included in this section.

Section 2 discusses the toxic effects and clinical manifestations of lead poisoning and effects of lead intoxication on pathways in heme synthesis. The adverse effects on both male and female reproductive capacity and on the fetus are also discussed.

Section 3 outlines the recommended medical evaluation of the worker exposed to inorganic lead, including details of the medical history, physical examination, and recommended laboratory tests, which are based on the toxic effects of lead as discussed in Section 2.

Section 4 provides detailed information concerning the laboratory tests available for the monitoring of exposed workers. Included also is a discussion of the relative value of each test and the limitations and precautions which are necessary in the interpretation of the laboratory results.

I. Medical Surveillance and Monitoring Requirements for Workers Exposed to Inorganic Lead

Under the interim final standard for inorganic lead in the construction industry, initial medical surveillance consisting of biological monitoring to include blood lead and ZPP level determination shall be provided to employees exposed to at or above the action level on any one day. In addition, a program of biological monitoring is to be made available to all employees exposed above the action level at any time and additional medical surveillance is to be made available to all employees exposed to lead above 30 ug/m(3) TWA for more than 30 days each year and whose BLL exceeds 40 ug/dl. This program consists of periodic blood sampling and medical evaluation to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician.

Under this program, the blood lead level (BLL) of all employees who are exposed to lead above 30 ug/m(3) for more than 30 days per year or whose blood lead is above 40 ug/dl but exposed for no more than 30 days per year is to be determined at least every two months for the first six months of exposure and every six months thereafter. The frequency is increased to every two months for employees whose last blood lead level was 40 ug/dl or above. For employees who are removed from exposure to lead due to an elevated blood lead, a new blood lead level must be measured monthly. A zinc protoporphyrin (ZPP) measurement is strongly recommended on each occasion that a blood lead level measurement is made.

An annual medical examination and consultation performed under the guidelines discussed in Section 3 is to be made available to each employee exposed above 30 ug/m(3) for more than 30 days per year for whom a blood test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 ug/dl. Also, an examination is to be given to all employees prior to their assignment to an area in which airborne lead concentrations reach or exceed the 30 ug/m(3) for more than 30 days per year. In addition, a medical examination must be provided as soon as possible after notification by an employee that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice regarding lead exposure and the ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during respirator use. An examination is also to be made available to each employee removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited or specially protected pursuant to medical recommendations.

Results of biological monitoring or the recommendations of an examining physician may necessitate removal of an employee from further lead exposure pursuant to the standard's medical removal protection (MRP) program. The object of the MRP program is to provide temporary medical removal to workers either with substantially elevated blood lead levels or otherwise at risk of sustaining material health impairment from continued substantial exposure to lead.

Under the standard's ultimate worker removal criteria, a worker is to be removed from any work having an eight hour TWA exposure to lead of 30 ug/m(3) when his or her blood lead level reaches 50 ug/dl and is confirmed by a second follow-up blood lead level performed within two weeks after the employer receives the results of the first blood sampling test. Return of the employee to his or her job status depends on a worker's blood lead level declining to 40 ug/dl.

As part of the interim standard, the employer is required to notify in writing each employee whose blood lead level exceeds 40 ug/dl. In addition each such employee is to be informed that the standard requires medical removal with MRP benefits, discussed below, when an employee's blood lead level exceeds the above defined limit.

In addition to the above blood lead level criterion, temporary worker removal may also take place as a result of medical determinations and recommendations. Written medical opinions must be prepared after each examination pursuant to the standard. If the examining physician includes a medical finding, determination or opinion that the employee has a medical condition which places the employee at increased risk of material health impairment from exposure to lead, then the employee must be removed from exposure to lead at or above 30 ug/m(3). Alternatively, if the examining physician recommends special protective measures for an employee (e.g., use of a powered air purifying respirator) or recommends limitations on an employee's exposure to lead, then the employer must implement these recommendations.

Recommendations may be more stringent than the specific provisions of the standard. The examining physician, therefore, is given broad flexibility to tailor special protective procedures to the needs of individual employees. This flexibility extends to the evaluation and management of pregnant workers and male and female workers who are planning to raise children. Based on the history, physical examination, and laboratory studies, the physician might recommend special protective measures or medical removal for an employee who is pregnant or who is planning to conceive a child when, in the physician's judgment, continued exposure to lead at the current job would pose a significant risk. The return of the employee to his or her former job status, or the removal of special protections or limitations, depends upon the examining physician determining that the employee is no longer at increased risk of material impairment or that special measures are no longer needed.

During the period of any form of special protection or removal, the employer must maintain the worker's earnings, seniority, and other employment rights and benefits (as though the worker had not been removed) for a period of up to 18 months or for as long as the job the employee was removed from lasts if less than 18 months. This economic protection will maximize meaningful worker participation in the medical surveillance program, and is appropriate as part of the employer's overall obligation to provide a safe and healthful workplace. The provisions of MRP benefits during the employee's removal period may, however, be conditioned upon participation in medical surveillance.

The lead standard provides for a multiple physician review in cases where the employee wishes a second opinion concerning potential lead poisoning or toxicity. If an employee wishes a second opinion, he or she can make an appointment with a physician of his or her choice. This second physician will review the findings, recommendations or determinations of the first physician and conduct any examinations, consultations or tests deemed necessary in an attempt to make a final medical determination. If the first and second physicians do not agree in their assessment they must try to resolve their differences. If they cannot reach an agreement then they must designate a third physician to resolve the dispute.

The employer must provide examining and consulting physicians with the following specific information: a copy of the lead regulations and all appendices, a description of the employee's duties as related to exposure, the exposure level or anticipated level to lead and any other toxic substances (if applicable), a description of personal protective equipment used, blood lead levels, and all prior written

medical opinions regarding the employee in the employer's possession or control. The employer must also obtain from the physician and provide the employee with a written medical opinion containing blood lead levels, the physician's opinion as to whether the employee is at risk of material impairment to health, any recommended protective measures for the employee if further exposure is permitted, as well as any recommended limitations upon an employee's use of respirators.

Employers must instruct each physician not to reveal to the employer in writing or in any other way his or her findings, laboratory results, or diagnoses which are felt to be unrelated to occupational lead exposure. They must also instruct each physician to advise the employee of any occupationally or non-occupationally related medical condition requiring further treatment or evaluation.

The standard provides for the use of respirators where engineering and other primary controls are not effective. However, the use of respirator protection shall not be used in lieu of temporary medical removal due to elevated blood lead levels or findings that an employee is at risk of material health impairment. This is based on the numerous inadequacies of respirators including skin rash where the facepiece makes contact with the skin, unacceptable stress to breathing in some workers with underlying cardiopulmonary impairment, difficulty in providing adequate fit, the tendency for respirators to create additional hazards by interfering with vision, hearing, and mobility, and the difficulties of assuring the maximum effectiveness of a complicated work practice program involving respirators. Respirators do, however, serve a useful function where engineering and work practice controls are inadequate by providing supplementary, interim, or short-term protection, provided they are properly selected for the environment in which the employee will be working, properly fitted to the employee, maintained and cleaned periodically, and worn by the employee when required.

In its interim final standard on occupational exposure to inorganic lead in the construction industry, OSHA has prohibited prophylactic chelation. Diagnostic and therapeutic chelation are permitted only under the supervision of a licensed physician with appropriate medical monitoring in an acceptable clinical setting. The decision to initiate chelation therapy must be made on an individual basis and take into account the severity of symptoms felt to be a result of lead toxicity along with blood lead levels, ZPP levels, and other laboratory tests as appropriate. EDTA and penicillamine which are the primary chelating agents used in the therapy of occupational lead poisoning have significant potential side effects and their use must be justified on the basis of expected benefits to the worker. Unless frank and severe symptoms are present, therapeutic chelation is not recommended, given the opportunity to remove a worker from exposure and allow the body to naturally excrete accumulated lead. As a diagnostic aid, the chelation mobilization test using CA-EDTA has limited applicability. According to some investigators, the test can differentiate between lead - induced and other nephropathies. The test may also provide an estimation of the mobile fraction of the total body lead burden.

Employers are required to assure that accurate records are maintained on exposure assessment, including environmental monitoring, medical surveillance, and medical removal for each employee. Exposure assessment records must be kept for at least 30 years. Medical surveillance records must be kept for the duration of employment plus 30 years except in cases where the employment was less than one year. If duration of employment is less than one year, the employer need not retain this record beyond the term of employment if the record is provided to the employee upon termination of employment. Medical removal records also must be maintained for the duration of employment. All records required under the standard must be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health. Employers must also make environmental and biological monitoring and medical removal records available to affected employees and to former employees or their authorized employee representatives. Employees or their specifically designated representatives have access to their entire medical surveillance records.

In addition, the standard requires that the employer inform all workers exposed to lead at or above 30 ug/m(3) of the provisions of the standard and all its appendices, the purpose and description of medical surveillance and provisions for medical removal protection if temporary removal is required. An understanding of the potential health effects of lead exposure by all exposed employees along with full understanding of their rights under the lead standard is essential for an effective monitoring program.

II. Adverse Health Effects of Inorganic Lead

Although the toxicity of lead has been known for 2,000 years, the knowledge of the complex relationship between lead exposure and human response is still being refined. Significant research into the toxic properties of lead continues throughout the world, and it should be anticipated that our understanding of thresholds of effects and margins of safety will be improved in future years. The provisions of the lead standard are founded on two prime medical judgments: first, the prevention of adverse health effects from exposure to lead throughout a working lifetime requires that worker blood lead levels be maintained at or below 40 ug/dl and second, the blood lead levels of workers, male or female, who intend to parent in the near future should be maintained below 30 ug/dl to minimize adverse reproductive health effects to the parents and developing fetus. The adverse effects of lead on reproduction are being actively researched and OSHA encourages the physician to remain abreast of recent developments in the area to best advise pregnant workers or workers planning to conceive children.

The spectrum of health effects caused by lead exposure can be subdivided into five developmental stages: normal, physiological changes of uncertain significance, pathophysiological changes, overt symptoms (morbidity), and mortality. Within this process there are no sharp distinctions, but rather a continuum of effects. Boundaries between categories overlap due to the wide variation of individual responses and exposures in the working population. OSHA's development of the lead standard focused on pathophysiological changes as well as later stages of disease.

1. Heme Synthesis Inhibition. The earliest demonstrated effect of lead involves its ability to inhibit at least two enzymes of the heme synthesis pathway at very low blood levels. Inhibition of delta aminolevulinic acid dehydrase (ALA-D) which catalyzes the conversion of delta-aminolevulinic acid (ALA) to protoporphyrin is observed at a blood lead level below 20 ug/dl. At a blood lead level of 40 ug/dl, more than 20 percent of the population would have 70 percent inhibition of ALA-D. There is an exponential increase in ALA excretion at blood lead levels greater than 40 ug/dl.

Another enzyme, ferrochelatase, is also inhibited at low blood lead levels. Inhibition of ferrochelatase leads to increased free erythrocyte protoporphyrin (FEP) in the blood which can then bind to zinc to yield zinc protoporphyrin. At a blood lead level of 50 ug/dl or greater, nearly 100 percent of the population will have an increase in FEP. There is also an exponential relationship between blood lead levels greater than 40 ug/dl and the associated ZPP level, which has led to the development of the ZPP screening test for lead exposure.

While the significance of these effects is subject to debate, it is OSHA's position that these enzyme disturbances are early stages of a disease process which may eventually result in the clinical symptoms of lead poisoning. Whether or not the effects do progress to the later stages of clinical disease, disruption of these enzyme processes over a working lifetime is considered to be a material impairment of health.

One of the eventual results of lead - induced inhibition of enzymes in the heme synthesis pathway is anemia which can be asymptomatic if mild but associated with a wide array of symptoms including dizziness, fatigue, and tachycardia when more severe. Studies have indicated that lead levels as low as 50 ug/dl can be associated with a definite decreased hemoglobin, although most

cases of lead - induced anemia, as well as shortened red-cell survival times, at lead levels exceeding 80 ug/dl. Inhibited hemoglobin synthesis is more common in chronic cases whereas shortened erythrocyte life span is more common in acute cases.

In lead - induced anemias, there is usually a reticulocytosis along with the presence of basophilic stippling, and ringed sideroblasts, although none of the above are pathognomonic for lead - induced anemia.

2. Neurological Effects. Inorganic lead has been found to have toxic effects on both the central and peripheral nervous . The earliest stages of lead - induced central nervous system effects first manifest themselves in the form of behavioral disturbances and central nervous system symptoms including irritability, restlessness, insomnia and other sleep disturbances, fatigue, vertigo, headache, poor memory, tremor, depression, and apathy. With more severe exposure, symptoms can progress to drowsiness, stupor, hallucinations, delirium, convulsions and coma.

The most severe and acute form of lead poisoning which usually follows ingestion or inhalation of large amounts of lead is acute encephalopathy which may arise precipitously with the onset of intractable seizures, coma, cardiorespiratory arrest, and death within 48 hours.

While there is disagreement about what exposure levels are needed to produce the earliest symptoms, most experts agree that symptoms definitely can occur at blood lead levels of 60 ug/dl whole blood and therefore recommend a 40 ug/dl maximum. The central nervous system effects frequently are not reversible following discontinued exposure or chelation therapy and when improvement does occur, it is almost always only partial.

The peripheral neuropathy resulting from lead exposure characteristically involves only motor function with minimal sensory damage and has a marked predilection for the extensor muscles of the most active extremity. The peripheral can occur with varying degrees of severity. The earliest and mildest form which can be detected in workers with blood lead levels as low as 50 ug/dl is manifested by slowing of motor nerve conduction velocity often without clinical symptoms. With progression of the neuropathy there is development of painless extensor muscle weakness usually involving the extensor muscles of the fingers and hand in the most active upper extremity, followed in severe cases by wrist drop or, much less commonly, foot drop.

In addition to slowing of nerve conduction, electromyographical studies in patients with blood lead levels greater than 50 ug/dl have demonstrated a decrease in the number of acting motor unit potentials, an increase in the duration of motor unit potentials, and spontaneous pathological activity including fibrillations and fasciculations. Whether these effects occur at levels of 40 ug/dl is undetermined.

While the peripheral neuropathies can occasionally be reversed with therapy, again such recovery is not assured particularly in the more severe neuropathies and often improvement is only partial. The lack of reversibility is felt to be due in part to segmental demyelination.

3. Gastrointestinal. Lead may also affect the gastrointestinal system producing abdominal colic or diffuse abdominal pain, constipation, obstipation, diarrhea, anorexia, nausea and vomiting. Lead colic rarely develops at blood lead levels below 80 ug/dl.

4. Renal. Renal toxicity represents one of the most serious health effects of lead poisoning. In the early stages of disease nuclear inclusion bodies can frequently be identified in proximal renal tubular cells. Renal function remains normal and the changes in this stage are probably reversible. With more

advanced disease there is progressive interstitial fibrosis and impaired renal function. Eventually extensive interstitial fibrosis ensues with sclerotic glomeruli and dilated and atrophied proximal tubules; all represent end stage kidney disease. Azotemia can be progressive, eventually resulting in frank uremia necessitating dialysis. There is occasionally associated hypertension and hyperuricemia with or without gout.

Early kidney disease is difficult to detect. The urinalysis is normal in early lead nephropathy and the blood urea nitrogen and serum creatinine increase only when two-thirds of kidney function is lost. Measurement of creatinine clearance can often detect earlier disease as can other methods of measurement of glomerular filtration rate. An abnormal Ca-EDTA mobilization test has been used to differentiate between lead - induced and other nephropathies, but this procedure is not widely accepted. A form of Fanconi syndrome with aminoaciduria, glycosuria, and hyperphosphaturia indicating severe injury to the proximal renal tubules is occasionally seen in children.

5. Reproductive effects. Exposure to lead can have serious effects on reproductive function in both males and females. In male workers exposed to lead there can be a decrease in sexual drive, impotence, decreased ability to produce healthy sperm, and sterility. Malformed sperm (teratospermia), decreased number of sperm (hypospermia), and sperm with decreased motility (asthenospermia) can all occur. Teratospermia has been noted at mean blood lead levels of 53 ug/dl and hypospermia and asthenospermia at 41 ug/dl. Furthermore, there appears to be a dose - response relationship for teratospermia in lead exposed workers.

Women exposed to lead may experience menstrual disturbances including dysmenorrhea, menorrhagia and amenorrhea. Following exposure to lead, women have a higher frequency of sterility, premature births, spontaneous miscarriages, and stillbirths.

Germ cells can be affected by lead and cause genetic damage in the egg or sperm cells before conception and result in failure to implant, miscarriage, stillbirth, or birth defects.

Infants of mothers with lead poisoning have a higher mortality during the first year and suffer from lowered birth weights, slower growth, and nervous system disorders.

Lead can pass through the placental barrier and lead levels in the mother's blood are comparable to concentrations of lead in the umbilical cord at birth. Transplacental passage becomes detectable at 12-14 weeks of gestation and increases until birth.

There is little direct data on damage to the fetus from exposure to lead but it is generally assumed that the fetus and newborn would be at least as susceptible to neurological damage as young children. Blood lead levels of 50-60 ug/dl in children can cause significant neurobehavioral impairments and there is evidence of hyperactivity at blood levels as low as 25 ug/dl. Given the overall body of literature concerning the adverse health effects of lead in children, OSHA feels that the blood lead level in children should be maintained below 30 ug/dl with a population mean of 15 ug/dl. Blood lead levels in the fetus and newborn likewise should not exceed 30 ug/dl.

Because of lead's ability to pass through the placental barrier and also because of the demonstrated adverse effects of lead on reproductive function in both the male and female as well as the risk of genetic damage of lead on both the ovum and sperm, OSHA recommends a 30 ug/dl maximum permissible blood lead level in both males and females who wish to bear children.

6. Other toxic effects. Debate and research continue on the effects of lead on the human body. Hypertension has frequently been noted in occupationally exposed individuals although it is difficult to assess whether this is due to lead's adverse effects on the kidney or if some other mechanism is

involved. Vascular and electrocardiographic changes have been detected but have not been well characterized. Lead is thought to impair thyroid function and interfere with the pituitary-adrenal axis, but again these effects have not been well defined.

III. Medical Evaluation

The most important principle in evaluating a worker for any occupational disease including lead poisoning is a high index of suspicion on the part of the examining physician. As discussed in Section 2, lead can affect numerous organ systems and produce a wide array of signs and symptoms, most of which are non-specific and subtle in nature at least in the early stages of disease. Unless serious concern for lead toxicity is present, many of the early clues to diagnosis may easily be overlooked.

The crucial initial step in the medical evaluation is recognizing that a worker's employment can result in exposure to lead. The worker will frequently be able to define exposures to lead and lead containing materials but often will not volunteer this information unless specifically asked. In other situations the worker may not know of any exposures to lead but the suspicion might be raised on the part of the physician because of the industry or occupation of the worker. Potential occupational exposure to lead and its compounds occur in many occupations in the construction industry, including demolition and salvaging operations, removal or encapsulation of materials containing lead, construction, alteration, repair or renovation of structures containing lead, transportation, disposal, storage or containment of lead or lead - containing materials on construction sites, and maintenance operations associated with construction activities.

Once the possibility for lead exposure is raised, the focus can then be directed toward eliciting information from the medical history, physical exam, and finally from laboratory data to evaluate the worker for potential lead toxicity.

A complete and detailed work history is important in the initial evaluation. A listing of all previous employment with information on job description, exposure to fumes or dust, known exposures to lead or other toxic substances, a description of any personal protective equipment used, and previous medical surveillance should all be included in the worker's record. Where exposure to lead is suspected, information concerning on-the-job personal hygiene, smoking or eating habits in work areas, laundry procedures, and use of any protective clothing or respiratory protection equipment should be noted. A complete work history is essential in the medical evaluation of a worker with suspected lead toxicity, especially when long term effects such as neurotoxicity and nephrotoxicity are considered.

The medical history is also of fundamental importance and should include a listing of all past and current medical conditions, current medications including proprietary drug intake, previous surgeries and hospitalizations, allergies, smoking history, alcohol consumption, and also non-occupational lead exposures such as hobbies (hunting, riflery). Also known childhood exposures should be elicited. Any previous history of hematological, neurological, gastrointestinal, renal, psychological, gynecological, genetic, or reproductive problems should be specifically noted.

A careful and complete review of systems must be performed to assess both recognized complaints and subtle or slowly acquired symptoms which the worker might not appreciate as being significant. The review of symptoms should include the following:

1. General - weight loss, fatigue, decreased appetite.

2. Head, Eyes, Ears, Nose, Throat (HEENT) - headaches, visual disturbances or decreased visual acuity, hearing deficits or tinnitus, pigmentation of the oral mucosa, or metallic taste in mouth.

3. Cardio-pulmonary - shortness of breath, cough, chest pains, palpitations, or orthopnea.

4. Gastrointestinal - nausea, vomiting, heartburn, abdominal pain, constipation or diarrhea.

5. Neurologic - irritability, insomnia, weakness (fatigue), dizziness, loss of memory, confusion, hallucinations, incoordination, ataxia, decreased strength in hands or feet, disturbances in gait, difficulty in climbing stairs, or seizures.

6. Hematologic - pallor, easy fatigability, abnormal blood loss, melena.

7. Reproductive (male and female and spouse where relevant) - history of infertility, impotence, loss of libido, abnormal menstrual periods, history of miscarriages, stillbirths, or children with birth defects.

8. Musculo-skeletal - muscle and joint pains.

The physical examination should emphasize the neurological, gastrointestinal, and cardiovascular systems. The worker's weight and blood pressure should be recorded and the oral mucosa checked for pigmentation characteristic of a possible Burtonian or lead line on the gingiva. It should be noted, however, that the lead line may not be present even in severe lead poisoning if good oral hygiene is practiced.

The presence of pallor on skin examination may indicate an anemia which, if severe, might also be associated with a tachycardia. If an anemia is suspected, an active search for blood loss should be undertaken including potential blood loss through the gastrointestinal tract.

A complete neurological examination should include an adequate mental status evaluation including a search for behavioral and psychological disturbances, memory testing, evaluation for irritability, insomnia, hallucinations, and mental clouding. Gait and coordination should be examined along with close observation for tremor. A detailed evaluation of peripheral nerve function including careful sensory and motor function testing is warranted. Strength testing particularly of extensor muscle groups of all extremities is of fundamental importance.

Cranial nerve evaluation should also be included in the routine examination.

The abdominal examination should include auscultation for bowel sounds and abdominal bruits and palpation for organomegaly, masses, and diffuse abdominal tenderness.

Cardiovascular examination should evaluate possible early signs of congestive heart failure. Pulmonary status should be addressed particularly if respirator protection is contemplated.

As part of the medical evaluation, the interim lead standard requires the following laboratory studies:

1. Blood lead level

2. Hemoglobin and hematocrit determinations, red cell indices, and examination of the peripheral blood smear to evaluate red blood cell morphology

3. Blood urea nitrogen

4. Serum creatinine

5. Routine urinalysis with microscopic examination.

6. A zinc protoporphyrin level.

In addition to the above, the physician is authorized to order any further laboratory or other tests which he or she deems necessary in accordance with sound medical practice. The evaluation must also include pregnancy testing or laboratory evaluation of male fertility if requested by the employee. Additional tests which are probably not warranted on a routine basis but may be appropriate when blood lead and ZPP levels are equivocal include delta aminolevulinic acid and coproporphyrin concentrations in the urine, and dark-field illumination for detection of basophilic stippling in red blood cells.

If an anemia is detected further studies including a careful examination of the peripheral smear, reticulocyte count, stool for occult blood, serum iron, total iron binding capacity, bilirubin, and, if appropriate, vitamin B12 and folate may be of value in attempting to identify the cause of the anemia.

If a peripheral neuropathy is suspected, nerve conduction studies are warranted both for diagnosis and as a basis to monitor any therapy.

If renal disease is questioned, a 24 hour urine collection for creatinine clearance, protein, and electrolytes may be indicated. Elevated uric acid levels may result from lead - induced renal disease and a serum uric acid level might be performed.

An electrocardiogram and chest x-ray may be obtained as deemed appropriate.

Sophisticated and highly specialized testing should not be done routinely and where indicated should be under the direction of a specialist.

IV. Laboratory Evaluation

The blood lead level at present remains the single most important test to monitor lead exposure and is the test used in the medical surveillance program under the lead standard to guide employee medical removal. The ZPP has several advantages over the blood lead level. Because of its relatively recent development and the lack of extensive data concerning its interpretation, the ZPP currently remains an ancillary test.

This section will discuss the blood lead level and ZPP in detail and will outline their relative advantages and disadvantages. Other blood tests currently available to evaluate lead exposure will also be reviewed.

The blood lead level is a good index of current or recent lead absorption when there is no anemia present and when the worker has not taken any chelating agents. However, blood lead levels along with urinary lead levels do not necessarily indicate the total body burden of lead and are not adequate measures of past exposure. One reason for this is that lead has a high affinity for bone and up to 90 percent of the body's total lead is deposited there. A very important component of the total lead body burden is lead in soft tissue (liver, kidney, and brain). This fraction of the lead body burden, the biologically active lead, is not entirely reflected by blood lead levels since it is a function of the dynamics of lead absorption, distribution, deposition in bone and excretion. Following discontinuation of exposure to lead, the excess body burden is only slowly mobilized from bone and other relatively stable body stores and excreted. Consequently, a high blood lead level may only represent recent heavy exposure to lead without a significant total body excess and likewise a low blood lead level does not exclude an elevated total body burden of lead.

Also due to its correlation with recent exposures, the blood lead level may vary considerably over

short time intervals.

To minimize laboratory error and erroneous results due to contamination, blood specimens must be carefully collected after thorough cleaning of the skin with appropriate methods using lead - free blood containers and analyzed by a reliable laboratory. Under the standard, samples must be analyzed in laboratories which are approved by OSHA. Analysis is to be made using atomic absorption spectrophotometry, anodic stripping voltammetry or any method which meets the accuracy requirements set forth by the standard.

The determination of lead in urine is generally considered a less reliable monitoring technique than analysis of whole blood primarily due to individual variability in urinary excretion capacity as well as the technical difficulty of obtaining accurate 24 hour urine collections. In addition, workers with renal insufficiency, whether due to lead or some other , may have decreased lead clearance and consequently urine lead levels may underestimate the true lead burden. Therefore, urine lead levels should not be used as a routine test.

The zinc protoporphyrin test, unlike the blood lead determination, measures an adverse metabolic effect of lead and as such is a better indicator of lead toxicity than the level of blood lead itself. The level of ZPP reflects lead absorption over the preceding 3 to 4 months, and therefore is a better indicator of lead body burden. The ZPP requires more time than the blood lead to read significantly elevated levels; the return to normal after discontinuing lead exposure is also slower. Furthermore, the ZPP test is simpler, faster, and less expensive to perform and no contamination is possible. Many investigators believe it is the most reliable means of monitoring chronic lead absorption.

Zinc protoporphyrin results from the inhibition of the enzyme ferrochelatase which catalyzes the insertion of an iron molecule into the protoporphyrin molecule, which then becomes heme. If iron is not inserted into the molecule then zinc, having a greater affinity for protoporphyrin, takes the place of the iron, forming ZPP.

An elevation in the level of circulating ZPP may occur at blood lead levels as low as 20-30 ug/dl in some workers. Once the blood lead level has reached 40 ug/dl there is more marked rise in the ZPP value from its normal range of less than 100 ug/dl 100 ml. Increases in blood lead levels beyond 40 ug/100 g are associated with exponential increases in ZPP.

Whereas blood lead levels fluctuate over short time spans, ZPP levels remain relatively stable. ZPP is measured directly in red blood cells and is present for the cell's entire 120 day life-span. Therefore, the ZPP level in blood reflects the average ZPP production over the previous 3-4 months and consequently the average lead exposure during that time interval.

It is recommended that a hematocrit be determined whenever a confirmed ZPP of 50 ug/100 ml whole blood is obtained to rule out a significant underlying anemia. If the ZPP is in excess of 100 ug/100 ml and not associated with abnormal elevations in blood lead levels, the laboratory should be checked to be sure that blood leads were determined using atomic absorption spectrophotometry anodic stripping voltammetry, or any method which meets the accuracy requirements set forth by the standard by an OSHA approved laboratory which is experienced in lead level determinations. Repeat periodic blood lead studies should be obtained in all individuals with elevated ZPP levels to be certain that an associated elevated blood lead level has not been missed due to transient fluctuations in blood leads.

ZPP has a characteristic fluorescence spectrum with a peak at 594 nm which is detectable with a hematofluorimeter. The hematofluorimeter is accurate and portable and can provide on-site, instantaneous results for workers who can be frequently tested via a finger prick.

However, careful attention must be given to calibration and quality control procedures. Limited data on blood lead-ZPP correlations and the ZPP levels which are associated with the adverse health effects discussed in Section 2 are the major limitations of the test. Also it is difficult to correlate ZPP levels with environmental exposure and there is some variation of response with age and sex. Nevertheless, the ZPP promises to be an important diagnostic test for the early detection of lead toxicity and its value will increase as more data is collected regarding its relationship to other manifestations of lead poisoning.

Levels of delta-aminolevulinic acid (ALA) in the urine are also used as a measure of lead exposure. Increasing concentrations of ALA are believed to result from the inhibition of the enzyme delta-aminolevulinic acid dehydrase (ALA-D). Although the test is relatively easy to perform, inexpensive, and rapid, the disadvantages include variability in results, the necessity to collect a complete 24 hour urine sample which has a specific gravity greater than 1.010, and also the fact that ALA decomposes in the presence of light.

The pattern of porphyrin excretion in the urine can also be helpful in identifying lead intoxication. With lead poisoning, the urine concentrations of coproporphyrins I and II, porphobilinogen and uroporphyrin I rise. The most important increase, however, is that of coproporphyrin III; levels may exceed 5,000 ug/1 in the urine in lead poisoned individuals, but its correlation with blood lead levels and ZPP are not as good as those of ALA. Increases in urinary porphyrins are not diagnostic of lead toxicity and may be seen in porphyria, some liver diseases, and in patients with high reticulocyte counts.

Summary. The Occupational Safety and Health Administration's interim standard for inorganic lead in the construction industry places significant emphasis on the medical surveillance of all workers exposed to levels of inorganic lead above 30 ug/m(3) TWA. The physician has a fundamental role in this surveillance program, and in the operation of the medical removal protection program.

Even with adequate worker education on the adverse health effects of lead and appropriate training in work practices, personal hygiene and other control measures, the physician has a primary responsibility for evaluating potential lead toxicity in the worker. It is only through a careful and detailed medical and work history, a complete physical examination and appropriate laboratory testing that an accurate assessment can be made. Many of the adverse health effects of lead toxicity are either irreversible or only partially reversible and therefore early detection of disease is very important.

This document outlines the medical monitoring program as defined by the occupational safety and health standard for inorganic lead. It reviews the adverse health effects of lead poisoning and describes the important elements of the history and physical examinations as they relate to these adverse effects. Finally, the appropriate laboratory testing for evaluating lead exposure and toxicity is presented.

It is hoped that this review and discussion will give the physician a better understanding of the OSHA standard with the ultimate goal of protecting the health and well-being of the worker exposed to lead under his or her care.

Appendix D

Qualitative and Quantitative Fit Test Protocols

Removed

29 CFR 1926.64
PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS

Purpose. This section contains requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards.

(a) Application.

(1) This section applies to the following:

(i) A process which involves a chemical at or above the specified threshold quantities listed in Appendix A to this section;

(ii) A process which involves a flammable liquid or gas (as defined in 1926.59(c) of this part) on site in one location, in a quantity of 10,000 pounds (4535.9 kg) or more except for:

(A) Hydrocarbon fuels used solely for workplace consumption as a fuel (e.g., propane used for comfort heating, gasoline for vehicle refueling), if such fuels are not a part of a process containing another highly hazardous chemical covered by this standard;

(B) Flammable liquids stored in atmospheric tanks or transferred which are kept below their normal boiling point without benefit of chilling or refrigeration.

(2) This section does not apply to:

(i) Retail facilities;

(ii) Oil or gas well drilling or servicing operations; or,

(iii) Normally unoccupied remote facilities.

(b) Definitions.

Atmospheric tank means a storage tank which has been designed to operate at pressures from atmospheric through 0.5 p.s.i.g. (pounds per square inch gauge, 3.45 Kpa).

Boiling point means the boiling point of a liquid at a pressure of 14.7 pounds per square inch absolute (p.s.i.a.) (760 mm.). For the purposes of this section, where an accurate boiling point is unavailable for the material in question, or for mixtures which do not have a constant boiling point, the 10 percent point of a distillation performed in accordance with the Standard Method of Test for Distillation of Petroleum Products, ASTM D-86-62, may be used as the boiling point of the liquid.

Catastrophic release means a major uncontrolled emission, fire, or explosion, involving one or more highly hazardous chemicals, that presents serious danger to employees in the workplace.

Facility means the buildings, containers or equipment which contain a process.

Highly hazardous chemical means a substance possessing toxic, reactive, flammable, or explosive properties and specified by paragraph (a)(1) of this section.

Hot work means work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations.

Normally unoccupied remote facility means a facility which is operated, maintained or serviced by employees who visit the facility only periodically to check its operation and to perform necessary operating or

maintenance tasks. No employees are permanently stationed at the facility. Facilities meeting this definition are not contiguous with, and must be geographically remote from all other buildings, processes or persons.

Process means any activity involving a highly hazardous chemical including any use, storage, manufacturing, handling, or the on-site movement of such chemicals, or combination of these activities. For purposes of this definition, any group of vessels which are interconnected and separate vessels which are located such that a highly hazardous chemical could be involved in a potential release shall be considered a single process.

Replacement in kind means a replacement which satisfies the design specification.

Trade secret means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D contained in §1926.59 sets out the criteria to be used in evaluating trade secrets.

(c) Employee participation.

(1) Employers shall develop a written plan of action regarding the implementation of the employee participation required by this paragraph.

(2) Employers shall consult with employees and their representatives on the conduct and development of process hazards analyses and on the development of the other elements of process safety management in this standard.

(3) Employers shall provide to employees and their representatives access to process hazard analyses and to all other information required to be developed under this standard.

(d) Process safety information. In accordance with the schedule set forth in paragraph (e)(1) of this section, the employer shall complete a compilation of written process safety information before conducting any process hazard analysis required by the standard. The compilation of written process safety information is to enable the employer and the employees involved in operating the process to identify and understand the hazards posed by those processes involving highly hazardous chemicals. This process safety information shall include information pertaining to the hazards of the highly hazardous chemicals used or produced by the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

(1) Information pertaining to the hazards of the highly hazardous chemicals in the process. This information shall consist of at least the following:

(i) Toxicity information;

(ii) Permissible exposure limits;

(iii) Physical data;

(iv) Reactivity data:

(v) Corrosivity data;

(vi) Thermal and chemical stability data; and

(vii) Hazardous effects of inadvertent mixing of different materials that could foreseeably occur.

Note: Material Safety Data Sheets meeting the requirements of 29 CFR 1926.59(g) may be used to comply with this requirement to the extent they contain the information required by this subparagraph.

(2) Information pertaining to the technology of the process.

(i) Information concerning the technology of the process shall include at least the following:

(A) A block flow diagram or simplified process flow diagram (see Appendix B to this section);

(B) Process chemistry;

(C) Maximum intended inventory;

(D) Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and,

(E) An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

(ii) Where the original technical information no longer exists, such information may be developed in conjunction with the process hazard analysis in sufficient detail to support the analysis.

(3) Information pertaining to the equipment in the process.

(i) Information pertaining to the equipment in the process shall include:

(A) Materials of construction;

(B) Piping and instrument diagrams (P&ID's);

(C) Electrical classification;

(D) Relief system design and design basis;

(E) Ventilation system design;

(F) Design codes and standards employed;

(G) Material and energy balances for processes built after May 26, 1992; and,

(H) Safety systems (e.g. interlocks, detection or suppression systems).

(ii) The employer shall document that equipment complies with recognized and generally accepted good engineering practices.

(iii) For existing equipment designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the employer shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.

(e) Process hazard analysis.

(1) The employer shall perform an initial process hazard analysis (hazard evaluation) on processes covered by this standard. The process hazard analysis shall be appropriate to the complexity of the process and shall identify, evaluate, and control the hazards involved in the process. Employers shall determine and document the priority order for conducting process hazard analyses based on a rationale which includes such considerations as extent of the process hazards, number of potentially affected employees, age of the process, and operating history of the process. The process hazard analysis shall be conducted as soon as possible, but not later than the following schedule:

(i) No less than 25 percent of the initial process hazards analyses shall be completed by May 26, 1994;

(ii) No less than 50 percent of the initial process hazards analyses shall be completed by May 26, 1995;

(iii) No less than 75 percent of the initial process hazards analyses shall be completed by May 26, 1996;

(iv) All initial process hazards analyses shall be completed by May 26, 1997.

(v) Process hazards analyses completed after May 26, 1997, which meet the requirements of this paragraph are acceptable as initial process hazards analyses. These process hazard analyses shall be updated and revalidated, based on their completion date, in accordance with paragraph (e)(6) of this standard.

(2) The employer shall use one or more of the following methodologies that are appropriate to determine and evaluate the hazards of the process being analyzed.

(i) What-If;

(ii) Checklist;

(iii) What-If/Checklist;

(iv) Hazard and Operability Study (HAZOP);

(v) Failure Mode and Effects Analysis (FMEA);

(vi) Fault Tree Analysis; or

(vii) An appropriate equivalent methodology.

(3) The process hazard analysis shall address:

(i) The hazards of the process;

(ii) The identification of any previous incident which had a likely potential for catastrophic consequences in the workplace;

(iii) Engineering and administrative controls applicable to the hazards and their interrelationships

such as appropriate application of detection methodologies to provide early warning of releases. (Acceptable detection methods might include process monitoring and control instrumentation with alarms, and detection hardware such as hydrocarbon sensors.);

(iv) Consequences of failure of engineering and administrative controls;

(v) Facility siting;

(vi) Human factors; and

(vii) A qualitative evaluation of a range of the possible safety and health effects of failure of controls on employees in the workplace.

(4) The process hazard analysis shall be performed by a team with expertise in engineering and process operations, and the team shall include at least one employee who has experience and knowledge specific to the process being evaluated. Also, one member of the team must be knowledgeable in the specific process hazard analysis methodology being used.

(5) The employer shall establish a system to promptly address the team's findings and recommendations; assure that the recommendations are resolved in a timely manner and that the resolution is documented; document what actions are to be taken; complete actions as soon as possible; develop a written schedule of when these actions are to be completed; communicate the actions to operating, maintenance and other employees whose work assignments are in the process and who may be affected by the recommendations or actions.

(6) At least every five (5) years after the completion of the initial process hazard analysis, the process hazard analysis shall be updated and revalidated by a team meeting the requirements in paragraph (e)(4) of this section, to assure that the process hazard analysis is consistent with the current process.

(7) Employers shall retain process hazards analyses and updates or revalidations for each process covered by this section, as well as the documented resolution of recommendations described in paragraph (e)(5) of this section for the life of the process.

(f) Operating procedures.

(1) The employer shall develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information and shall address at least the following elements.

(i) Steps for each operating phase:

(A) Initial startup;

(B) Normal operations;

(C) Temporary operations;

(D) Emergency shutdown including the conditions under which emergency shutdown is required, and the assignment of shutdown responsibility to qualified operators to ensure that emergency shutdown is executed in a safe and timely manner.

(E) Emergency Operations;

(F) Normal shutdown; and,

(G) Startup following a turnaround, or after an emergency shutdown.

(ii) Operating limits:

(A) Consequences of deviation; and

(B) Steps required to correct or avoid deviation.

(iii) Safety and health considerations:

(A) Properties of, and hazards presented by, the chemicals used in the process;

(B) Precautions necessary to prevent exposure, including engineering controls, administrative controls, and personal protective equipment;

(C) Control measures to be taken if physical contact or airborne exposure occurs;

(D) Quality control for raw materials and control of hazardous chemical inventory levels; and,

(E) Any special or unique hazards.

(iv) Safety systems and their functions.

(2) Operating procedures shall be readily accessible to employees who work in or maintain a process.

(3) The operating procedures shall be reviewed as often as necessary to assure that they reflect current operating practice, including changes that result from changes in process chemicals, technology, and equipment, and changes to facilities. The employer shall certify annually that these operating procedures are current and accurate.

(4) The employer shall develop and implement safe work practices to provide for the control of hazards during operations such as lockout/tagout; confined space entry; opening process equipment or piping; and control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel. These safe work practices shall apply to employees and contractor employees.

(g) Training.

(1) Initial training.

(i) Each employee presently involved in operating a process, and each employee before being involved in operating a newly assigned process, shall be trained in an overview of the process and in the operating procedures as specified in paragraph (f) of this section. The training shall include emphasis on the specific safety and health hazards, emergency operations including shutdown, and safe work practices applicable to the employee's job tasks.

(ii) In lieu of initial training for those employees already involved in operating a process on May 26,

1992, an employer may certify in writing that the employee has the required knowledge, skills, and abilities to safely carry out the duties and responsibilities as specified in the operating procedures.

(2) Refresher training. Refresher training shall be provided at least every three years, and more often if necessary, to each employee involved in operating a process to assure that the employee understands and adheres to the current operating procedures of the process. The employer, in consultation with the employees involved in operating the process, shall determine the appropriate frequency of refresher training.

(3) Training documentation. The employer shall ascertain that each employee involved in operating a process has received and understood the training required by this paragraph. The employer shall prepare a record which contains the identity of the employee, the date of training, and the means used to verify that the employee understood the training.

(h) Contractors.

(1) Application. This paragraph applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process. It does not apply to contractors providing incidental services which do not influence process safety, such as janitorial work, food and drink services, laundry, delivery or other supply services.

(2) Employer responsibilities.

(i) The employer, when selecting a contractor, shall obtain and evaluate information regarding the contract employer's safety performance and programs.

(ii) The employer shall inform contract employers of the known potential fire, explosion, or toxic release hazards related to the contractor's work and the process.

(iii) The employer shall explain to contract employers the applicable provisions of the emergency action plan required by paragraph (n) of this section.

(iv) The employer shall develop and implement safe work practices consistent with paragraph (f)(4) of this section, to control the entrance, presence and exit of contract employers and contract employees in covered process areas.

(v) The employer shall periodically evaluate the performance of contract employers in fulfilling their obligations as specified in paragraph (h)(3) of this section.

(vi) The employer shall maintain a contract employee injury and illness log related to the contractor's work in process areas.

(3) Contract employer responsibilities.

(i) The contract employer shall assure that each contract employee is trained in the work practices necessary to safely perform his/her job.

(ii) The contract employer shall assure that each contract employee is instructed in the known potential fire, explosion, or toxic release hazards related to his/her job and the process, and the applicable provisions of the emergency action plan.

(iii) The contract employer shall document that each contract employee has received and understood

the training required by this paragraph. The contract employer shall prepare a record which contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training.

(iv) The contract employer shall assure that each contract employee follows the safety rules of the facility including the safe work practices required by paragraph (f)(4) of this section.

(v) The contract employer shall advise the employer of any unique hazards presented by the contract employer's work, or of any hazards found by the contract employer's work.

(i) Pre-startup safety review.

(1) The employer shall perform a pre-startup safety review for new facilities and for modified facilities when the modification is significant enough to require a change in the process safety information.

(2) The pre-startup safety review shall confirm that prior to the introduction of highly hazardous chemicals to a process:

(i) Construction and equipment is in accordance with design specifications;

(ii) Safety, operating, maintenance, and emergency procedures are in place and are adequate;

(iii) For new facilities, a process hazard analysis has been performed and recommendations have been resolved or implemented before startup; and modified facilities meet the requirements contained in management of change, paragraph (l) of this section.

(iv) Training of each employee involved in operating a process has been completed.

(j) Mechanical integrity.

(1) Application. Paragraphs (j)(2) through (j)(6) of this section apply to the following process equipment:

(i) Pressure vessels and storage tanks;

(ii) Piping systems (including piping components such as valves);

(iii) Relief and vent systems and devices;

(iv) Emergency shutdown systems;

(v) Controls (including monitoring devices and sensors, alarms, and interlocks) and,

(vi) Pumps.

(2) Written procedures. The employer shall establish and implement written procedures to maintain the on-going integrity of process equipment.

(3) Training for process maintenance activities. The employer shall train each employee involved in maintaining the on-going integrity of process equipment in an overview of that process and its hazards and in the procedures applicable to the employee's job tasks to assure that the employee can perform the job tasks in a safe manner.

(4) Inspection and testing.

(i) Inspections and tests shall be performed on process equipment.

(ii) Inspection and testing procedures shall follow recognized and generally accepted good engineering practices.

(iii) The frequency of inspections and tests of process equipment shall be consistent with applicable manufacturers' recommendations and good engineering practices, and more frequently if determined to be necessary by prior operating experience.

(iv) The employer shall document each inspection and test that has been performed on process equipment. The documentation shall identify the date of the inspection or test, the name of the person who performed the inspection or test, the serial number or other identifier of the equipment on which the inspection or test was performed, a description of the inspection or test performed, and the results of the inspection or test.

(5) Equipment deficiencies. The employer shall correct deficiencies in equipment that are outside acceptable limits (defined by the process safety information in paragraph (d) of this section) before further use or in a safe and timely manner when necessary means are taken to assure safe operation.

(6) Quality assurance.

(i) In the construction of new plants and equipment, the employer shall assure that equipment as it is fabricated is suitable for the process application for which they will be used.

(ii) Appropriate checks and inspections shall be performed to assure that equipment is installed properly and consistent with design specifications and the manufacturer's instructions.

(iii) The employer shall assure that maintenance materials, spare parts and equipment are suitable for the process application for which they will be used.

(k) Hot work permit.

(1) The employer shall issue a hot work permit for hot work operations conducted on or near a covered process.

(2) The permit shall document that the fire prevention and protection requirements in 29 CFR 1926.352 have been implemented prior to beginning the hot work operations; it shall indicate the date(s) authorized for hot work; and identify the object on which hot work is to be performed. The permit shall be kept on file until completion of the hot work operations.

(l) Management of change.

(1) The employer shall establish and implement written procedures to manage changes (except for "replacements in kind") to process chemicals, technology, equipment, and procedures; and, changes to facilities that affect a covered process.

(2) The procedures shall assure that the following considerations are addressed prior to any change:

(i) The technical basis for the proposed change;

(ii) Impact of change on safety and health;

(iii) Modifications to operating procedures;

(iv) Necessary time period for the change; and,

(v) Authorization requirements for the proposed change.

(3) Employees involved in operating a process and maintenance and contract employees whose job tasks will be affected by a change in the process shall be informed of, and trained in, the change prior to start-up of the process or affected part of the process.

(4) If a change covered by this paragraph results in a change in the process safety information required by paragraph (d) of this section, such information shall be updated accordingly.

(5) If a change covered by this paragraph results in a change in the operating procedures or practices required by paragraph (f) of this section, such procedures or practices shall be updated accordingly.

(m) Incident investigation.

(1) The employer shall investigate each incident which resulted in, or could reasonably have resulted in a catastrophic release of highly hazardous chemical in the workplace.

(2) An incident investigation shall be initiated as promptly as possible, but not later than 48 hours following the incident.

(3) An incident investigation team shall be established and consist of at least one person knowledgeable in the process involved, including a contract employee if the incident involved work of the contractor, and other persons with appropriate knowledge and experience to thoroughly investigate and analyze the incident.

(4) A report shall be prepared at the conclusion of the investigation which includes at a minimum:

(i) Date of incident;

(ii) Date investigation began;

(iii) A description of the incident;

(iv) The factors that contributed to the incident; and,

(v) Any recommendations resulting from the investigation.

(5) The employer shall establish a system to promptly address and resolve the incident report findings and recommendations. Resolutions and corrective actions shall be documented.

(6) The report shall be reviewed with all affected personnel whose job tasks are relevant to the incident findings including contract employees where applicable.

(7) Incident investigation reports shall be retained for five years.

(n) Emergency planning and response. The employer shall establish and implement an emergency action plan for the entire plant in accordance with the provisions of 29 CFR 1926.35(a). In addition, the emergency action plan shall include procedures for handling small releases. Employers covered under this standard may also be subject to the hazardous waste and emergency response provisions contained in 29 CFR 1926.65(a), (p) and (q).

(o) Compliance Audits.

(1) Employers shall certify that they have evaluated compliance with the provisions of this section at least every three years to verify that the procedures and practices developed under the standard are adequate and are being followed.

(2) The compliance audit shall be conducted by at least one person knowledgeable in the process.

(3) A report of the findings of the audit shall be developed.

(4) The employer shall promptly determine and document an appropriate response to each of the findings of the compliance audit, and document that deficiencies have been corrected.

(5) Employers shall retain the two (2) most recent compliance audit reports.

(p) Trade secrets.

(1) Employers shall make all information necessary to comply with the section available to those persons responsible for compiling the process safety information (required by paragraph (d) of this section), those assisting in the development of the process hazard analysis (required by paragraph (e) of this section), those responsible for developing the operating procedures (required by paragraph (f) of this section), and those involved in incident investigations (required by paragraph (m) of this section), emergency planning and response (paragraph (n) of this section) and compliance audits (paragraph (o) of this section) without regard to possible trade secret status of such information.

(2) Nothing in this paragraph shall preclude the employer from requiring the persons to whom the information is made available under paragraph (p)(1) of this section to enter into confidentiality agreements not to disclose the information as set forth in 29 CFR 1926.59.

(3) Subject to the rules and procedures set forth in 29 CFR 1926.59(i)(1) through (12), employees and their designated representatives shall have access to trade secret information contained within the process hazard analysis and other documents required to be developed by this standard.

Appendix A

List of Highly Hazardous Chemicals, Toxics and Reactives (Mandatory)

This Appendix contains a listing of toxic and reactive highly hazardous chemicals which present a potential for a catastrophic event at or above the threshold quantity.

CHEMICAL NAME	CAS*	TQ**
Acetaldehyde	75-07-0	2500
Acrolein (2-Propenal)	107-02-8	150

Acrylyl Chloride	814-68-6	250
Allyl Chloride	107-05-1	1000
Allylamine	107-11-9	1000
Alkylaluminums	Varies	5000
Ammonia, Anhydrous	7664-41-7	10000
Ammonia solutions (> 44% ammonia by weight)	7664-41-7	15000
Ammonium Perchlorate	7790-98-9	7500
Ammonium Permanganate	7787-36-2	7500
Arsine (also called Arsenic Hydride)	7784-42-1	100
Bis(Chloromethyl) Ether	542-88-1	100
Boron Trichloride	10294-34-5	2500
Boron Trifluoride	7637-07-2	250
Bromine	7726-95-6	1500
Bromine Chloride	13863-41-7	1500
Bromine Pentafluoride	7789-30-2	2500
Bromine Trifluoride	7787-71-5	15000
3-Bromopropyne (also called Propargyl Bromide)	106-96-7	100
Butyl Hydroperoxide (Tertiary)	75-91-2	5000
Butyl Perbenzoate (Tertiary)	614-45-9	7500
Carbonyl Chloride (see Phosgene)	75-44-5	100
Carbonyl Fluoride	353-50-4	2500
Cellulose Nitrate (concentration > 12.6% nitrogen	9004-70-0	2500
Chlorine	7782-50-5	1500
Chlorine Dioxide	10049-04-4	1000
Chlorine Pentrafluoride	13637-63-3	1000
Chlorine Trifluoride	7790-91-2	1000
Chlorodiethylaluminum (also called Diethylaluminum Chloride)	96-10-6	5000

1-Chloro-2,4-Dinitrobenzene	97-00-7	5000	
Chloromethyl Methyl Ether	107-30-2	500	
Chloropicrin	76-06-2	500	
Chloropicrin and Methyl Bromide mixture	None	1500	
Chloropicrin and Methyl Chloride mixture	None	1500	
Cumene Hydroperoxide	80-15-9	5000	
Cyanogen	460-19-5	2500	
Cyanogen Chloride	506-77-4	500	
Cyanuric Fluoride	675-14-9	100	
Diacetyl Peroxide (concentration > 70%)	110-22-5	5000	
Diazomethane	334-88-3	500	
Dibenzoyl Peroxide	94-36-0	7500	
Diborane	19287-45-7	100	
Dibutyl Peroxide (Tertiary)	110-05-4	5000	
Dichloro Acetylene	7572-29-4	250	
Dichlorosilane	4109-96-0	2500	
Diethylzinc	557-20-0	10000	
Diisopropyl Peroxydicarbonate	105-64-6	7500	
Dilauroyl Peroxide	105-74-8	7500	
Dimethyldichlorosilane	75-78-5	1000	
Dimethylhydrazine, 1,1-	57-14-7	1000	
Dimethylamine, Anhydrous	124-40-3	2500	
2,4-Dinitroaniline	97-02-9	5000	
Ethyl Methyl Ketone Peroxide (also Methyl Ethyl Ketone Peroxide; concentration > 60%)	1338-23-4	5000	
Ethyl Nitrite	109-95-5	5000	
Ethylamine	75-04-7	7500	
Ethylene Fluorohydrin	371-62-0	100	
Ethylene Oxide	75-21-8	5000	

Ethyleneimine	151-56-4	1000		
Fluorine	7782-41-4		1000	
Formaldehyde (Formalin)	50-00-0	1000		
Furan	110-00-9	500		
Hexafluoroacetone	684-16-2	5000		
Hydrochloric Acid, Anhydrous	7647-01-0			5000
Hydrofluoric Acid, Anhydrous	7664-39-3			1000
Hydrogen Bromide	10035-10-6	5000		
Hydrogen Chloride	7647-01-0		5000	
Hydrogen Cyanide, Anhydrous	74-90-8		1000	
Hydrogen Fluoride	7664-39-3		1000	
Hydrogen Peroxide (52% by weight or greater)	7722-84-1		7500	
Hydrogen Selenide	7783-07-5		150	
Hydrogen Sulfide	7783-06-4		1500	
Hydroxylamine	7803-49-8		2500	
Iron, Pentacarbonyl	13463-40-6		250	
Isopropylamine	75-31-0	5000		
Ketene	463-51-4	100		
Methacrylaldehyde	78-85-3	1000		
Methacryloyl Chloride	920-46-7	150		
Methacryloyloxyethyl Isocyanate	30674-80-7			100
Methyl Acrylonitrile	126-98-7	250		
Methylamine, Anhydrous	74-89-5	1000		
Methyl Bromide	74-83-9	2500		
Methyl Chloride	74-87-3	15000		
Methyl Chloroformate	79-22-1	500		
Methyl Ethyl Ketone Peroxide (concentration > 60%)	1338-23-4		5000	
Methyl Fluoroacetate	453-18-9	100		

Methyl Fluorosulfate	421-20-5	100	
Methyl Hydrazine	60-34-4	100	
Methyl Iodide	74-88-4	7500	
Methyl Isocyanate	624-83-9	250	
Methyl Mercaptan	74-93-1	5000	
Methyl Vinyl Ketone	79-84-4	100	
Methyltrichlorosilane	75-79-6	500	
Nickel Carbonly (Nickel Tetracarbonyl)	13463-39-3	150	
Nitric Acid (94.5% by weight or greater)	7697-37-2	500	
Nitric Oxide	10102-43-9	250	
Nitroaniline (para Nitroaniline	100-01-6	5000	
Nitromethane	75-52-5	2500	
Nitrogen Dioxide	10102-44-0	250	
Nitrogen Oxides (NO;NO2;N2O4;N2O3)	10102-44-0	250	
Nitrogen Tetroxide (also called Nitrogen Peroxide)	10544-72-6	250	
Nitrogen Trifluoride	7783-54-2	5000	
Nitrogen Trioxide	10544-73-7	250	
Oleum (65% to 80% by weight; also called Fuming Sulfuric Acid)	8014-94-7	1000	
Osmium Tetroxide	20816-12-0	100	
Oxygen Difluoride (Fluorine Monoxide)	7783-41-7	100	
Ozone	10028-15-6	100	
Pentaborane	19624-22-7	100	
Peracetic Acid (concentration > 60% Acetic Acid; also called Peroxyacetic Acid)	79-21-0	1000	
Perchloric Acid (concentration > 60% by weight)	7601-90-3	5000	
Perchloromethyl Mercaptan	594-42-3	150	
Perchloryl Fluoride	7616-94-6	5000	

Peroxyacetic Acid (concentration > 60% Acetic Acid; also called Peracetic Acid)	79-21-0	1000	
Phosgene (also called Carbonyl Chloride)	75-44-5	100	
Phosphine (Hydrogen Phosphide)	7803-51-2	100	
Phosphorus Oxychloride (also called Phosphoryl Chloride)	10025-87-3	1000	
Phosphorus Trichloride	7719-12-2	1000	
Phosphoryl Chloride (also called Phosphorus Oxychloride)	10025-87-3	1000	
Propargyl Bromide	106-96-7	100	
Propyl Nitrate	627-3-4	2500	
Sarin	107-44-8	100	
Selenium Hexafluoride	7783-79-1	1000	
Stibine (Antimony Hydride)	7803-52-3	500	
Sulfur Dioxide (liquid)	7446-09-5	1000	
Sulfur Pentafluoride	5714-22-7	250	
Sulfur Tetrafluoride	7783-60-0	250	
Sulfur Trioxide (also called Sulfuric Anhydride)	7446-11-9	1000	
Sulfuric Anhydride (also called Sulfur Trioxide)	7446-11-9	1000	
Tellurium Hexafluoride	7783-80-4	250	
Tetrafluoroethylene	116-14-3	5000	
Tetrafluorohydrazine	10036-47-2	5000	
Tetramethyl Lead	75-74-1	1000	
Thionyl Chloride	7719-09-7	250	
Trichloro (chloromethyl) Silane	1558-25-4	100	
Trichloro (dichlorophenyl) Silane	27137-85-5	2500	
Trichlorosilane	10025-78-2	5000	
Trifluorochloroethylene	79-38-9	10000	
Trimethyoxysilane	2487-90-3	1500	

***Chemical Abstract Service Number**

****Threshold Quantity in Pounds (Amount necessary to be covered by this standard.)**

Appendix B

Block Flow Diagram and Simplified Process Flow Diagram (Nonmandatory)

Appendix C

Compliance Guidelines and Recommendations for
Process Safety Management
(Nonmandatory)

This appendix serves as a nonmandatory guideline to assist employers and employees in complying with the requirements of this section, as well as provides other helpful recommendations and information. Examples presented in this appendix are not the only means of achieving the performance goals in the standard. This appendix neither adds nor detracts from the requirements of the standard.

1. Introduction to Process Safety Management. The major objective of process safety management of highly hazardous chemicals is to prevent unwanted releases of hazardous chemicals especially into locations which could expose employees and others to serious hazards. An effective process safety management program requires a systematic approach to evaluating the whole process. Using this approach the process design, process technology, operational and maintenance activities and procedures, nonroutine activities and procedures, emergency preparedness plans and procedures, training programs, and other elements which impact the process are all considered in the evaluation. The various lines of defense that have been incorporated into the design and operation of the process to prevent or mitigate the release of hazardous chemicals need to be evaluated and strengthened to assure their effectiveness at each level. Process safety management is the proactive identification, evaluation and mitigation or prevention of chemical releases that could occur as a result of failures in process, procedures or equipment.

The process safety management standard targets highly hazardous chemicals that have the potential to cause a catastrophic incident. This standard as a whole is to aid employers in their efforts to prevent or mitigate episodic chemical releases that could lead to a catastrophe in the workplace and possibly to the surrounding community. To control these types of hazards, employers need to develop the necessary expertise, experiences, judgement and proactive initiative within their workforce to properly implement and maintain an effective process safety management program as envisioned in the OSHA standard. This OSHA standard is required by the Clean Air Act Amendments as is the Environmental Protection Agency's Risk Management Plan. Employers, who merge the two sets of requirements into their process safety management program, will better assure full compliance with each as well as enhancing their relationship with the local community.

While OSHA believes process safety management will have a positive effect on the safety of employees in workplaces and also offers other potential benefits to employers (increased productivity), smaller businesses which may have limited resources available to them at this time, might consider alternative avenues of decreasing the risks associated with highly hazardous chemicals at their workplaces. One method which might be considered is the reduction in the inventory of the highly hazardous chemical. This reduction in inventory will result in a reduction of the risk or potential for a catastrophic incident. Also, employers including small employers may be able to establish more efficient inventory control by reducing the quantities of highly hazardous chemicals on site below the established threshold quantities. This reduction can be accomplished by ordering smaller shipments and maintaining the minimum inventory necessary for efficient and safe operation. When reduced inventory is not feasible, then the employer might consider dispersing inventory to several locations on site. Dispersing storage into locations where a release in one location will not cause a release in another location is a practical method to also reduce the risk or potential for

catastrophic incidents.

2. Employee Involvement in Process Safety Management. Section 304 of the Clean Air Act Amendments states that employers are to consult with their employees and their representatives regarding the employers efforts in the development and implementation of the process safety management program elements and hazard assessments. Section 304 also requires employers to train and educate their employees and to inform affected employees of the findings from incident investigations required by the process safety management program. Many employers, under their safety and health programs, have already established means and methods to keep employees and their representatives informed about relevant safety and health issues and employers may be able to adapt these practices and procedures to meet their obligations under this standard. Employers who have not implemented an occupational safety and health program may wish to form a safety and health committee of employees and management representatives to help the employer meet the obligations specified by this standard. These committees can become a significant ally in helping the employer to implement and maintain an effective process safety management program for all employees.

3. Process Safety Information. Complete and accurate written information concerning process chemicals, process technology, and process equipment is essential to an effective process safety management program and to a process hazards analysis. The compiled information will be a necessary resource to a variety of users including the team that will perform the process hazards analysis as required under paragraph (e); those developing the training programs and the operating procedures; contractors whose employees will be working with the process; those conducting the pre-startup reviews; local emergency preparedness planners; and insurance and enforcement officials.

The information to be compiled about the chemicals, including process intermediates, needs to be comprehensive enough for an accurate assessment of the fire and explosion characteristics, reactivity hazards, the safety and health hazards to workers, and the corrosion and erosion effects on the process equipment and monitoring tools. Current material safety data sheet (MSDS) information can be used to help meet this requirement which must be supplemented with process chemistry information including runaway reaction and over pressure hazards if applicable.

Process technology information will be a part of the process safety information package and it is expected that it will include diagrams of the type shown in Appendix B of this section as well as employer established criteria for maximum inventory levels for process chemicals; limits beyond which would be considered upset conditions; and a qualitative estimate of the consequences or results of deviation that could occur if operating beyond the established process limits. Employers are encouraged to use diagrams which will help users understand the process.

A block flow diagram is used to show the major process equipment and interconnecting process flow lines and show flow rates, stream composition, temperatures, and pressures when necessary for clarity. The block flow diagram is a simplified diagram.

Process flow diagrams are more complex and will show all main flow streams including valves to enhance the understanding of the process, as well as pressures and temperatures on all feed and product lines within all major vessels, in and out of headers and heat exchangers, and points of pressure and temperature control. Also, materials of construction information, pump capacities and pressure heads, compressor horsepower and vessel design pressures and temperatures are shown when necessary for clarity. In addition, major components of control loops are usually shown along with key utilities on process flow diagrams.

Piping and instrument diagrams (P&Ids) may be the more appropriate type of diagrams to show some of the above details and to display the information for the piping designer and engineering staff. The P&IDs are to be used to describe the relationships between equipment and instrumentation as well as other relevant

information that will enhance clarity. Computer software programs which do P&Ids or other diagrams useful to the information package, may be used to help meet this requirement.

The information pertaining to process equipment design must be documented. In other words, what were the codes and standards relied on to establish good engineering practice. These codes and standards are published by such organizations as the American Society of Mechanical Engineers, American Petroleum Institute, American National Standards Institute, National Fire Protection Association, American Society for Testing and Materials, National Board of Boiler and Pressure Vessel Inspectors, National Association of Corrosion Engineers, American Society of Exchange Manufacturers Association, and model building code groups.

In addition, various engineering societies issue technical reports which impact process design. For example, the American Institute of Chemical Engineers has published technical reports on topics such as two phase flow for venting devices. This type of technically recognized report would constitute good engineering practice.

For existing equipment designed and constructed many years ago in accordance with the codes and standards available at that time and no longer in general use today, the employer must document which codes and standards were used and that the design and construction along with the testing, inspection and operation are still suitable for the intended use. Where the process technology requires a design which departs from the applicable codes and standards, the employer must document that the design and construction is suitable for the intended purpose.

4. Process Hazard Analysis. A process hazard analysis (PHA), sometimes called a process hazard evaluation, is one of the most important elements of the process safety management program. A PHA is an organized and systematic effort to identify and analyze the significance of potential hazards associated with the processing or handling of highly hazardous chemicals. A PHA provides information which will assist employers and employees in making decisions for improving safety and reducing the consequences of unwanted or unplanned releases of hazardous chemicals. A PHA is directed toward analyzing potential causes and consequences of fires, explosions, releases of toxic or flammable chemicals and major spills of hazardous chemicals. The PHA focuses on equipment, instrumentation, utilities, human actions (routine and nonroutine), and external factors that might impact the process. These considerations assist in determining the hazards and potential failure points or failure modes in a process.

The selection of a PHA methodology or technique will be influenced by many factors including the amount of existing knowledge about the process. Is it a process that has been operated for a long period of time with little or no innovation and extensive experience has been generated with its use? Or, is it a new process or one which has been changed frequently by the inclusion of innovative features? Also, the size and complexity of the process will influence the decision as to the appropriate PHA methodology to use. All PHA methodologies are subject to certain limitations. For example, the checklist methodology works well when the process is very stable and no changes are made, but it is not as effective when the process has undergone extensive change. The checklist may miss the most recent changes and consequently the changes would not be evaluated. Another limitation to be considered concerns the assumptions made by the team or analyst. The PHA is dependent on good judgement and the assumptions made during the study need to be documented and understood by the team and reviewer and kept for a future PHA.

The team conducting the PHA need to understand the methodology that is going to be used. A PHA team can vary in size from two people to a number of people with varied operational and technical backgrounds. Some team members may only be a part of the team for a limited time. The team leader needs to be fully knowledgeable in the proper implementation of the PHA methodology that is to be used and should be impartial in the evaluation. The other full or part time team members need to provide the team with expertise

in areas such as process technology, process design, operating procedures and practices, including how the work is actually performed, alarms, emergency procedures, instrumentation, maintenance procedures, both routine and nonroutine tasks, including how the tasks are authorized, procurement of parts and supplies, safety and health, and any other relevant subject as the need dictates. At least one team member must be familiar with the process. The ideal team will have an intimate knowledge of the standards, codes, specifications and regulations applicable to the process being studied. The selected team members need to be compatible and the team leader needs to be able to manage the team and the PHA study. The team needs to be able to work together while benefiting from the expertise of others on the team or outside the team, to resolve issues, and to forge a consensus on the findings of the study and the recommendations.

The application of a PHA to a process may involve the use of different methodologies for various parts of the process. For example, a process involving a series of unit operations of varying sizes, complexities, and ages may use different methodologies and team members for each operation. Then the conclusions can be integrated into one final study and evaluation. A more specific example is the use of a checklist PHA for a standard boiler or heat exchanger and the use of a Hazard and Operability PHA for the overall process. Also, for batch type processes like custom batch operations, a generic PHA of a representative batch may be used where there are only small changes of monomer or other ingredient ratios and the chemistry is documented for the full range and ratio of batch ingredients. Another process that might consider using a generic type of PHA is a gas plant. Often these plants are simply moved from site to site and therefore, a generic PHA may be used for these movable plants. Also, when an employer has several similar size gas plants and no sour gas is being processed at the site, then a generic PHA is feasible as long as the variations of the individual sites are accounted for in the PHA. Finally, when an employer has a large continuous process which has several control rooms for different portions of the process such as for a distillation tower and a blending operation, the employer may wish to do each segment separately and then integrate the final results.

Additionally, small businesses which are covered by this rule, will often have processes that have less storage volume, less capacity, and less complicated than processes at a large facility. Therefore, OSHA would anticipate that the less complex methodologies would be used to meet the process hazard analysis criteria in the standard. These process hazard analyses can be done in less time and with a few people being involved. A less complex process generally means that less data, P&IDs, and process information is needed to perform a process hazard analysis.

Many small businesses have processes that are not unique, such as cold storage lockers or water treatment facilities. Where employer associations have a number of members with such facilities, a generic PHA, evolved from a checklist or what-if questions, could be developed and used by each employer effectively to reflect his/her particular process; this would simplify compliance for them.

When the employer has a number of processes which require a PHA, the employer must set up a priority system of which PHAs to conduct first. A preliminary or gross hazard analysis may be useful in prioritizing the processes that the employer has determined are subject to coverage by the process safety management standard. Consideration should first be given to those processes with the potential of adversely affecting the largest number of employees. This prioritizing should consider the potential severity of a chemical release, the number of potentially affected employees, the operating history of the process such as the frequency of chemical releases, the age of the process and any other relevant factors. These factors would suggest a ranking order and would suggest either using a weighing factor system or a systematic ranking method. The use of a preliminary hazard analysis would assist an employer in determining which process should be of the highest priority and thereby the employer would obtain the greatest improvement in safety at the facility.

Detailed guidance on the content and application of process hazard analysis methodologies is available from the American Institute of Chemical Engineers' Center for Chemical Process Safety (see Appendix D).

5. Operating Procedures and Practices. Operating procedures describe tasks to be performed, data to be recorded, operating conditions to be maintained, samples to be collected, and safety and health precautions to be taken. The procedures need to be technically accurate, understandable to employees, and revised periodically to ensure that they reflect current operations. The process safety information package is to be used as a resource to better assure that the operating procedures and practices are consistent with the known hazards of the chemicals in the process and that the operating parameters are accurate. Operating procedures should be reviewed by engineering staff and operating personnel to ensure that they are accurate and provide practical instructions on how to actually carry out job duties safely.

Operating procedures will include specific instructions or details on what steps are to be taken or followed in carrying out the stated procedures. These operating instructions for each procedure should include the applicable safety precautions and should contain appropriate information on safety implications. For example, the operating procedures addressing operating parameters will contain operating instructions about pressure limits, temperature ranges, flow rates, what to do when an upset condition occurs, what alarms and instruments are pertinent if an upset condition occurs, and other subjects. Another example of using operating instructions to properly implement operating procedures is in starting up or shutting down the process. In these cases, different parameters will be required from those of normal operation. These operating instructions need to clearly indicate the distinctions between startup and normal operations such as the appropriate allowances for heating up a unit to reach the normal operating parameters. Also the operating instructions need to describe the proper method for increasing the temperature of the unit until the normal operating temperature parameters are achieved.

Computerized process control systems add complexity to operating instructions. These operating instructions need to describe the logic of the software as well as the relationship between the equipment and the control system; otherwise, it may not be apparent to the operator.

Operating procedures and instructions are important for training operating personnel. The operating procedures are often viewed as the standard operating practices (SOPs) for operations. Control room personnel and operating staff, in general, need to have a full understanding of operating procedures. If workers are not fluent in English then procedures and instructions need to be prepared in a second language understood by the workers. In addition, operating procedures need to be changed when there is a change in the process as a result of the management of change procedures. The consequences of operating procedure changes need to be fully evaluated and the information conveyed to the personnel. For example, mechanical changes to the process made by the maintenance department (like changing a valve from steel to brass or other subtle changes) need to be evaluated to determine if operating procedures and practices also need to be changed. All management of change actions must be coordinated and integrated with current operating procedures and operating personnel must be oriented to the changes in procedures before the change is made. When the process is shutdown in order to make a change, then the operating procedures must be updated before startup of the process.

Training in how to handle upset conditions must be accomplished as well as what operating personnel are to do in emergencies such as when a pump seal fails or a pipeline ruptures. Communication between operating personnel and workers performing work within the process area, such as nonroutine tasks, also must be maintained. The hazards of the tasks are to be conveyed to operating personnel in accordance with established procedures and to those performing the actual tasks. When the work is completed, operating personnel should be informed to provide closure on the job.

6. Employee Training. All employees, including maintenance and contractor employees, involved with highly hazardous chemicals need to fully understand the safety and health hazards of the chemicals and processes they work with for the protection of themselves, their fellow employees and the citizens of nearby

communities. Training conducted in compliance with §1926.59, the Hazard Communication standard, will help employees to be more knowledgeable about the chemicals they work with as well as familiarize them with reading and understanding MSDS. However, additional training in subjects such as operating procedures and safety work practices, emergency evacuation and response, safety procedures, routine and nonroutine work authorization activities, and other areas pertinent to process safety and health will need to be covered by an employer's training program.

In establishing their training programs, employers must clearly define the employees to be trained and what subjects are to be covered in their training. Employers in setting up their training program will need to clearly establish the goals and objectives they wish to achieve with the training that they provide to their employees. The learning goals or objectives should be written in clear measurable terms before the training begins. These goals and objectives need to be tailored to each of the specific training modules or segments. Employers should describe the important actions and conditions under which the employee will demonstrate competence or knowledge as well as what is acceptable performance.
Hands-on-training where employees are able to use their senses beyond listening, will enhance learning. For example, operating personnel, who will work in a control room or at control panels, would benefit by being trained at a simulated control panel or panels. Upset conditions of various types could be displayed on the simulator, and then the employee could go through the proper operating procedures to bring the simulator panel back to the normal operating parameters. A training environment could be created to help the trainee feel the full reality of the situation but, of course, under controlled conditions. This realistic type of training can be very effective in teaching employees correct procedures while allowing them to also see the consequences of what might happens if they do not follow established operating procedures. Other training techniques using videos or on-the-job training can also be very effective for teaching other job tasks, duties, or other important information. An effective training program will allow the employee to fully participate in the training process and to practice their skill or knowledge.

Employers need to periodically evaluate their training programs to see if the necessary skills, knowledge, and routines are being properly understood and implemented by their trained employees. The means or methods for evaluating the training should be developed along with the training program goals and objectives. Training program evaluation will help employers to determine the amount of training their employees understood, and whether the desired results were obtained. If, after the evaluation, it appears that the trained employees are not at the level of knowledge and skill that was expected, the employer will need to revise the training program, provide retraining, or provide more frequent refresher training sessions until the deficiency is resolved. Those who conducted the training and those who received the training should also be consulted as to how best to improve the training process. If there is a language barrier, the language known to the trainees should be used to reinforce the training messages and information.

Careful consideration must be given to assure that employees including maintenance and contract employees receive current and updated training. For example, if changes are made to a process, impacted employees must be trained in the changes and understand the effects of the changes on their job tasks (e.g., any new operating procedures pertinent to their tasks). Additionally, as already discussed the evaluation of the employee's absorption of training will certainly influence the need for training.

7. Contractors. Employers who use contractors to perform work in and around processes that involve highly hazardous chemicals, will need to establish a screening process so that they hire and use contractors who accomplish the desired job tasks without compromising the safety and health of employees at a facility. For contractors, whose safety performance on the job is not known to the hiring employer, the employer will need to obtain information on injury and illness rates and experience and should obtain contractor references. Additionally, the employer must assure that the contractor has the appropriate job skills, knowledge and certifications (such as for pressure vessel welders). Contractor work methods and experiences should be evaluated. For example, does the contractor conducting demolition work swing loads over operating

processes or does the contractor avoid such hazards?

Maintaining a site injury and illness log for contractors is another method employers must use to track and maintain current knowledge of work activities involving contract employees working on or adjacent to covered processes. Injury and illness logs of both the employer's employees and contract employees allow an employer to have full knowledge of process injury and illness experience. This log will also contain information which will be of use to those auditing process safety management compliance and those involved in incident investigations.

Contract employees must perform their work safely. Considering that contractors often perform very specialized and potentially hazardous tasks such as confined space entry activities and nonroutine repair activities it is quite important that their activities be controlled while they are working on or near a covered process. A permit system or work authorization system for these activities would also be helpful to all affected employers. The use of a work authorization system keeps an employer informed of contract employee activities, and as a benefit the employer will have better coordination and more management control over the work being performed in the process area. A well run and well maintained process where employee safety is fully recognized will benefit all of those who work in the facility whether they be contract employees or employees of the owner.

8. Pre-Startup Safety. For new processes, the employer will find a PHA helpful in improving the design and construction of the process from a reliability and quality point of view. The safe operation of the new process will be enhanced by making use of the PHA recommendations before final installations are completed. P&IDs are to be completed along with having the operating procedures in place and the operating staff trained to run the process before startup. The initial startup procedures and normal operating procedures need to be fully evaluated as part of the pre-startup review to assure a safe transfer into the normal operating mode for meeting the process parameters.

For existing processes that have been shutdown for turnaround, or modification, etc., the employer must assure that any changes other than "replacement in kind" made to the process during shutdown go through the management of change procedures. P&IDs will need to be updated as necessary, as well as operating procedures and instructions. If the changes made to the process during shutdown are significant and impact the training program, then operating personnel as well as employees engaged in routine and nonroutine work in the process area may need some refresher or additional training in light of the changes. Any incident investigation recommendations, compliance audits or PHA recommendations need to be reviewed as well to see what impacts they may have on the process before beginning the startup.

9. Mechanical Integrity. Employers will need to review their maintenance programs and schedules to see if there are areas where "breakdown" maintenance is used rather than an on-going mechanical integrity program. Equipment used to process, store, or handle highly hazardous chemicals needs to be designed, constructed, installed and maintained to minimize the risk of releases of such chemicals. This requires that a mechanical integrity program be in place to assure the continued integrity of process equipment. Elements of a mechanical integrity program include the identification and categorization of equipment and instrumentation, inspections and tests, testing and inspection frequencies, development of maintenance procedures, training of maintenance personnel, the establishment of criteria for acceptable test results, documentation of test and inspection results, and documentation of manufacturer recommendations as to meantime to failure for equipment and instrumentation.

The first line of defense an employer has available is to operate and maintain the process as designed, and to keep the chemicals contained. This line of defense is backed up by the next line of defense which is the controlled release of chemicals through venting to scrubbers or flares, or to surge or overflow tanks which are designed to receive such chemicals, etc. These lines of defense are the primary lines of defense or means to

prevent unwanted releases. The secondary lines of defense would include fixed fire protection systems like sprinklers, water spray, or deluge systems, monitor guns, etc., dikes, designed drainage systems, and other systems which would control or mitigate hazardous chemicals once an unwanted release occurs. These primary and secondary lines of defense are what the mechanical integrity program needs to protect and strengthen these primary and secondary lines of defenses where appropriate.

The first step of an effective mechanical integrity program is to compile and categorize a list of process equipment and instrumentation for inclusion in the program. This list would include pressure vessels, storage tanks, process piping, relief and vent systems, fire protection system components, emergency shutdown systems and alarms and interlocks and pumps. For the categorization of instrumentation and the listed equipment the employer would prioritize which pieces of equipment require closer scrutiny than others. Meantime to failure of various instrumentation and equipment parts would be known from the manufacturers data or the employer's experience with the parts, which would then influence the inspection and testing frequency and associated procedures. Also, applicable codes and standards such as the National Board Inspection Code, or those from the American Society for Testing and Material, American Petroleum Institute, National Fire Protection Association, American National Standards Institute, American Society of Mechanical Engineers, and other groups, provide information to help establish an effective testing and inspection frequency, as well as appropriate methodologies.
The applicable codes and standards provide criteria for external inspections for such items as foundation and supports, anchor bolts, concrete or steel supports, guy wires, nozzles and sprinklers, pipe hangers, grounding connections, protective coatings and insulation, and external metal surfaces of piping and vessels, etc. These codes and standards also provide information on methodologies for internal inspection, and a frequency formula based on the corrosion rate of the materials of construction. Also, erosion both internal and external needs to be considered along with corrosion effects for piping and valves. Where the corrosion rate is not known, a maximum inspection frequency is recommended, and methods of developing the corrosion rate are available in the codes. Internal inspections need to cover items such as vessel shell, bottom and head; metallic linings; nonmetallic linings; thickness measurements for vessels and piping; inspection for erosion, corrosion, cracking and bulges; internal equipment like trays, baffles, sensors and screens for erosion, corrosion or cracking and other deficiencies. Some of these inspections may be performed by state or local government inspectors under state and local statutes. However, each employer needs to develop procedures to ensure that tests and inspections are conducted properly and that consistency is maintained even where different employees may be involved. Appropriate training is to be provided to maintenance personnel to ensure that they understand the preventive maintenance program procedures, safe practices, and the proper use and application of special equipment or unique tools that may be required. This training is part of the overall training program called for in the standard.

A quality assurance system is needed to help ensure that the proper materials of construction are used, that fabrication and inspection procedures are proper, and that installation procedures recognize field installation concerns. The quality assurance program is an essential part of the mechanical integrity program and will help to maintain the primary and secondary lines of defense that have been designed into the process to prevent unwanted chemical releases or those which control or mitigate a release. "As built" drawings, together with certifications of coded vessels and other equipment, and materials of construction need to be verified and retained in the quality assurance documentation. Equipment installation jobs need to be properly inspected in the field for use of proper materials and procedures and to assure that qualified craftsmen are used to do the job. The use of appropriate gaskets, packing, bolts, valves, lubricants and welding rods need to be verified in the field. Also, procedures for installation of safety devices need to be verified, such as the torque on the bolts on ruptured disc installations, uniform torque on flange bolts, proper installation of pump seals, etc. If the quality of parts is a problem, it may be appropriate to conduct audits of the equipment supplier's facilities to better assure proper purchases of required equipment which is suitable for its intended service. Any changes in equipment that may become necessary will need to go through the management of change procedures.

10. Nonroutine Work Authorizations. Nonroutine work which is conducted in process areas needs to be controlled by the employer in a consistent manner. The hazards identified involving the work that is to be accomplished must be communicated to those doing the work, but also to those operating personnel whose work could affect the safety of the process. A work authorization notice or permit must have a procedure that describes the steps the maintenance supervisor, contractor representative or other person needs to follow to obtain the necessary clearance to get the job started. The work authorization procedures need to reference and coordinate, as applicable, lockout/tagout procedures, line breaking procedures, confined space entry procedures and hot work authorizations. This procedure also needs to provide clear steps to follow once the job is completed in order to provide closure for those that need to know the job is now completed and equipment can be returned to normal.

11. Managing Change. To properly manage changes to process chemicals, technology, equipment and facilities, one must define what is meant by change. In this process safety management standard, change includes all modifications to equipment, procedures, raw materials and processing conditions other than "replacement in kind." These changes need to be properly managed by identifying and reviewing them prior to implementation of the change. For example, the operating procedures contain the operating parameters (pressure limits, temperature ranges, flow rates, etc.) and the importance of operating within these limits. While the operator must have the flexibility to maintain safe operation within the established parameters, any operation outside of these parameters requires review and approval by a written management of change procedure.

Management of change covers such as changes in process technology and changes to equipment and instrumentation.

Changes in process technology can result from changes in production rates, raw materials, experimentation, equipment unavailability, new equipment, new product development, change in catalyst and changes in operating conditions to improve yield or quality. Equipment changes include among others change in materials of construction, equipment specifications, piping pre-arrangements, experimental equipment, computer program revisions and changes in alarms and interlocks. Employers need to establish means and methods to detect both technical changes and mechanical changes.

Temporary changes have caused a number of catastrophes over the years, and employers need to establish ways to detect temporary changes as well as those that are permanent. It is important that a time limit for temporary changes be established and monitored since, without control, these changes may tend to become permanent. Temporary changes are subject to the management of change provisions. In addition, the management of change procedures are used to insure that the equipment and procedures are returned to their original or designed conditions at the end of the temporary change. Proper documentation and review of these changes is invaluable in assuring that the safety and health considerations are being incorporated into the operating procedures and the process.

Employers may wish to develop a form or clearance sheet to facilitate the processing of changes through the management of change procedures. A typical change form may include a description and the purpose of the change, the technical basis for the change, safety and health considerations, documentation of changes for the operating procedures, maintenance procedures, inspection and testing, P&IDs, electrical classification, training and communications, pre-startup inspection, duration if a temporary change, approvals and authorization. Where the impact of the change is minor and well understood, a check list reviewed by an authorized person with proper communication to others who are affected may be sufficient. However, for a more complex or significant design change, a hazard evaluation procedure with approvals by operations, maintenance, and safety departments may be appropriate. Changes in documents such as P&IDs, raw materials, operating procedures, mechanical integrity programs, electrical classifications, etc., need to be

noted so that these revisions can be made permanent when the drawings and procedure manuals are updated. Copies of process changes need to be kept in an accessible location to ensure that design changes are available to operating personnel as well as to PHA team members when a PHA is being done or one is being updated.

12. Investigation of Incidents. Incident investigation is the process of identifying the underlying causes of incidents and implementing steps to prevent similar events from occurring. The intent of an incident investigation is for employers to learn from past experiences and thus avoid repeating past mistakes. The incidents for which OSHA expects employers to become aware and to investigate are the types of events which result in or could reasonably have resulted in a catastrophic release. Some of the events are sometimes referred to as "near misses," meaning that a serious consequence did not occur, but could have.

Employers need to develop in-house capability to investigate incidents that occur in their facilities. A team needs to be assembled by the employer and trained in the techniques of investigation including how to conduct interviews of witnesses, needed documentation and report writing. A multi-disciplinary team is better able to gather the facts of the event and to analyze them and develop plausible scenarios as to what happened, and why. Team members should be selected on the basis of their training, knowledge and ability to contribute to a team effort to fully investigate the incident. Employees in the process area where the incident occurred should be consulted, interviewed or made a member of the team. Their knowledge of the events form a significant set of facts about the incident which occurred. The report, its findings and recommendations are to be shared with those who can benefit from the information. The cooperation of employees is essential to an effective incident investigation. The focus of the investigation should be to obtain facts, and not to place blame. The team and the investigation process should clearly deal with all involved individuals in a fair, open and consistent manner.

13. Emergency Preparedness. Each employer must address what actions employees are to take when there is an unwanted release of highly hazardous chemicals. Emergency preparedness or the employer's tertiary (third) lines of defense are those that will be relied on along with the secondary lines of defense when the primary lines of defense which are used to prevent an unwanted release fail to stop the release. Employers will need to decide if they want employees to handle and stop small or minor incidental releases. Whether they wish to mobilize the available resources at the plant and have them brought to bear on a more significant release. Or whether employers want their employees to evacuate the danger area and promptly escape to a preplanned safe zone area, and allow the local community emergency response organizations to handle the release. Or whether the employer wants to use some combination of these actions. Employers will need to select how many different emergency preparedness or tertiary lines of defense they plan to have and then develop the necessary plans and procedures, and appropriately train employees in their emergency duties and responsibilities and then implement these lines of defense.

Employers at a minimum must have an emergency action plan which will facilitate the prompt evacuation of employees when an unwanted release of highly hazardous chemical. This means that the employer will have a plan that will be activated by an alarm system to alert employees when to evacuate and, that employees who are physically impaired, will have the necessary support and assistance to get them to the safe zone as well. The intent of these requirements is to alert and move employees to a safe zone quickly. Delaying alarms or confusing alarms are to be avoided. The use of process control centers or similar process buildings in the process area as safe areas is discouraged. Recent catastrophes have shown that a large life loss has occurred in these structures because of where they have been sited and because they are not necessarily designed to withstand over-pressures from shockwaves resulting from explosions in the process area.

Unwanted incidental releases of highly hazardous chemicals in the process area must be addressed by the employer as to what actions employees are to take. If the employer wants employees to evacuate the area, then the emergency action plan will be activated. For outdoor processes where wind direction is important for

selecting the safe route to a refuge area, the employer should place a wind direction indicator such as a wind sock or pennant at the highest point that can be seen throughout the process area. Employees can move in the direction of cross wind to upwind to gain safe access to the refuge area by knowing the wind direction.

If the employer wants specific employees in the release area to control or stop the minor emergency or incidental release, these actions must be planned for in advance and procedures developed and implemented. Preplanning for handling incidental releases for minor emergencies in the process area needs to be done, appropriate equipment for the hazards must be provided, and training conducted for those employees who will perform the emergency work before they respond to handle an actual release. The employer's training program, including the Hazard Communication standard training is to address the training needs for employees who are expected to handle incidental or minor releases.

Preplanning for releases that are more serious than incidental releases is another important line of defense to be used by the employer. When a serious release of a highly hazardous chemical occurs, the employer through preplanning will have determined in advance what actions employees are to take. The evacuation of the immediate release area and other areas as necessary would be accomplished under the emergency action plan. If the employer wishes to use plant personnel such as a fire brigade, spill control team, a hazardous materials team, or use employees to render aid to those in the immediate release area and control or mitigate the incident, these actions are covered by §1926.65, the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard. If outside assistance is necessary, such as through mutual aid agreements between employers or local government emergency response organizations, these emergency responders are also covered by HAZWOPER. The safety and health protections required for emergency responders are the responsibility of their employers and of the on-scene incident commander.

Responders may be working under very hazardous conditions and therefore the objective is to have them competently led by an on-scene incident commander and the commander's staff, properly equipped to do their assigned work safely, and fully trained to carry out their duties safely before they respond to an emergency. Drills, training exercises, or simulations with the local community emergency response planners and responder organizations is one means to obtain better preparedness. This close cooperation and coordination between plant and local community emergency preparedness managers will also aid the employer in complying with the Environmental Protection Agency's Risk Management Plan criteria.

One effective way for medium to large facilities to enhance coordination and communication during emergencies for on plant operations and with local community organizations is for employers to establish and equip an emergency control center. The emergency control center would be sited in a safe zone area so that it could be occupied throughout the duration of an emergency. The center would serve as the major communication link between the on-scene incident commander and plant or corporate management as well as with the local community officials. The communication equipment in the emergency control center should include a network to receive and transmit information by telephone, radio or other means. It is important to have a backup communication network in case of power failure or one communication means fails. The center should also be equipped with the plant layout and community maps, utility drawings including fire water, emergency lighting, appropriate reference materials such as a government agency notification list, company personnel phone list, SARA Title III reports and material safety data sheets, emergency plans and procedures manual, a listing with the location of emergency response equipment, mutual aid information, and access to meteorological or weather condition data and any dispersion modeling data.

14. Compliance Audits. Employers need to select a trained individual or assemble a trained team of people to audit the process safety management system and program. A small process or plant may need only one knowledgeable person to conduct an audit. The audit is to include an evaluation of the design and effectiveness of the process safety management system and a field inspection of the safety and health conditions and practices to verify that the employer's systems are effectively implemented. The audit should

be conducted or lead by a person knowledgeable in audit techniques and who is impartial towards the facility or area being audited. The essential elements of an audit program include planning, staffing, conducting the audit, evaluation and corrective action, follow-up and documentation.

Planning in advance is essential to the success of the auditing process. Each employer needs to establish the format, staffing, scheduling and verification methods prior to conducting the audit. The format should be designed to provide the lead auditor with a procedure or checklist which details the requirements of each section of the standard. The names of the audit team members should be listed as part of the format as well. The checklist, if properly designed, could serve as the verification sheet which provides the auditor with the necessary information to expedite the review and assure that no requirements of the standard are omitted. This verification sheet format could also identify those elements that will require evaluation or a response to correct deficiencies. This sheet could also be used for developing the follow-up and documentation requirements.

The selection of effective audit team members is critical to the success of the program. Team members should be chosen for their experience, knowledge, and training and should be familiar with the processes and with auditing techniques, practices and procedures. The size of the team will vary depending on the size and complexity of the process under consideration. For a large, complex, highly instrumented plant, it may be desirable to have team members with expertise in process engineering and design, process chemistry, instrumentation and computer controls, electrical hazards and classifications, safety and health disciplines, maintenance, emergency preparedness, warehousing or shipping, and process safety auditing. The team may use part-time members to provide for the depth of expertise required as well as for what is actually done or followed, compared to what is written.

An effective audit includes a review of the relevant documentation and process safety information, inspection of the physical facilities, and interviews with all levels of plant personnel. Utilizing the audit procedure and checklist developed in the preplanning stage, the audit team can systematically analyze compliance with the provisions of the standard and any other corporate policies that are relevant. For example, the audit team will review all aspects of the training program as part of the overall audit. The team will review the written training program for adequacy of content, frequency of training, effectiveness of training in terms of its goals and objectives as well as to how it fits into meeting the standard's requirements, documentation, etc. Through interviews, the team can determine the employee's knowledge and awareness of the safety procedures, duties, rules, emergency response assignments, etc. During the inspection, the team can observe actual practices such as safety and health policies, procedures, and work authorization practices. This approach enables the team to identify deficiencies and determine where corrective actions or improvements are necessary.

An audit is a technique used to gather sufficient facts and information, including statistical information, to verify compliance with standards. Auditors should select as part of their preplanning a sample size sufficient to give a degree of confidence that the audit reflects the level of compliance with the standard. The audit team, through this systematic analysis, should document areas which require corrective action as well as those areas where the process safety management system is effective and working in an effective manner. This provides a record of the audit procedures and findings, and serves as a baseline of operation data for future audits. It will assist future auditors in determining changes or trends from previous audits.

Corrective action is one of the most important parts of the audit. It includes not only addressing the identified deficiencies, but also planning, followup, and documentation. The corrective action process normally begins with a management review of the audit findings. The purpose of this review is to determine what actions are appropriate, and to establish priorities, timetables, resource allocations and requirements and responsibilities. In some cases, corrective action may involve a simple change in procedure or minor maintenance effort to remedy the concern. Management of change procedures need to be used, as appropriate, even for what may seem to be a minor change. Many of the deficiencies can be acted on promptly, while some may require

engineering studies or indepth review of actual procedures and practices. There may be instances where no action is necessary and this is a valid response to an audit finding. All actions taken, including an explanation where no action is taken on a finding, needs to be documented as to what was done and why.

It is important to assure that each deficiency identified is addressed, the corrective action to be taken noted, and the audit person or team responsible be properly documented by the employer. To control the corrective action process, the employer should consider the use of a tracking system. This tracking system might include periodic status reports shared with affected levels of management, specific reports such as completion of an engineering study, and a final implementation report to provide closure for audit findings that have been through management of change, if appropriate, and then shared with affected employees and management. This type of tracking system provides the employer with the status of the corrective action. It also provides the documentation required to verify that appropriate corrective actions were taken on deficiencies identified in the audit.

Appendix D
Sources of Further Information
(Nonmandatory)

1. Center for Chemical Process Safety, American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017, (212)705-7319.

2. "Guidelines for Hazard Evaluation Procedures," American Institute of Chemical Engineers; 345 East 47th Street, New York, NY 10017.

3. "Guidelines for Technical Management of Chemical Process Safety," Center for Chemical Process Safety of the American Institute of Chemical Engineers; 345 East 47th Street, New York, NY 10017.

4. "Evaluating Process Safety in the Chemical Industry," Chemical Manufacturers Association; 2501 M Street NW, Washington, DC 20037.

5. "Safe Warehousing of Chemicals," Chemical Manufacturers Association; 2501 M Street NW, Washington, DC 20037.

6. "Management of Process Hazards," American Petroleum Institute (API Recommended Practice 750); 1220 L Street, N.W., Washington, D.C. 20005.

7. "Improving Owner and Contractor Safety Performance," American Petroleum Institute (API Recommended Practice 2220); API, 1220 L Street N.W., Washington, D.C. 20005.

8. Chemical Manufacturers Association (CMA's Manager Guide), First Edition, September 1991; CMA, 2501 M Street, N.W., Washington, D.C. 20037.

9. "Improving Construction Safety Performance," Report A-3, The Business Roundtable; The Business Roundtable, 200 Park Avenue, New York, NY 10166. (Report includes criteria to evaluate contractor safety performance and criteria to enhance contractor safety performance).

10. "Recommended Guidelines for Contractor Safety and Health," Texas Chemical Council; Texas Chemical Council, 1402 Nueces Street, Austin, TX 78701-1534.

11. "Loss Prevention in the Process Industries," Volumes I and II; Frank P. Lees, Butterworth; London 1983.

12. "Safety and Health Program Management Guidelines," 1989; U.S. Department of Labor, Occupational Safety and Health Administration.

13. "Safety and Health Guide for the Chemical Industry," 1986, (OSHA 3091); U.S. Department of Labor, Occupational Safety and Health Administration; 200 Constitution Avenue, N.W., Washington, D.C. 20210.

14. "Review of Emergency Systems," June 1988; U.S. Environmental Protection Agency (EPA), Office of Solid Waste and Emergency Response, Washington, DC 20460.

15. "Technical Guidance for Hazards Analysis, Emergency Planning for Extremely Hazardous Substances," December 1987; U.S. Environmental Protection Agency (EPA), Federal Emergency

Management Administration (FEMA) and U.S. Department of Transportation (DOT), Washington, DC 20460.

16. "Accident Investigation...A New Approach," 1983, National Safety Council; 444 North Michigan Avenue, Chicago, IL 60611-3991.

17. "Fire & Explosion Index Hazard Classification Guide," 6th Edition, May 1987, Dow Chemical Company; Midland, Michigan 48674.

18. "Chemical Exposure Index," May 1988, Dow Chemical Company; Midland, Michigan 48674.

29 CFR 1926.65
HAZARDOUS WASTE OPERATIONS & EMERGENCY RESPONSE

(a) Scope, application, and definitions.

(1) Scope. This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

(i) Clean-up operations required by a governmental body, whether Federal, state, local or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

(ii) Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq);

(iii) Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

(iv) Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR Parts 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

(v) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

(2) Application.

(i) All requirements of part 1910 and part 1926 of title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1926.20(e)(1).

(ii) Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(i) through (a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).

(iii) Operations within the scope of paragraph (a)(1)(iv) of this section must comply only with the requirements of paragraph (p) of this section.

* Notes and Exceptions:

(A) All provisions of paragraph (p) of this section cover any treatment, storage or disposal (TSD) operation regulated by 40 CFR parts 264 and 265 or by state law authorized under RCRA, and required to have a permit or interim status from EPA pursuant to 40 CFR 270.1 or from a state agency pursuant to RCRA.

(B) Employers who are not required to have a permit or interim status because they are

conditionally exempt small quantity generators under 40 CFR 261.5 or are generators who qualify under 40 CFR 262.34 for exemptions from regulation under 40 CFR 262.34 for exemptions from regulation under 40 CFR parts 264, 265, and 270 ("excepted employers") are not covered by paragraphs (p)(1) through (p)(7) of this section. Excepted employers who are required by the EPA or state agency to have their employees engage in emergency response or who direct their employees to engage in emergency response are covered by paragraph (p)(8) of this section, and cannot be exempted by (p)(8)(i) of this section.

(C) If an area is used primarily for treatment, storage or disposal, any emergency response operations in that area shall comply with paragraph (p) (8) of this section. In other areas not used primarily for treatment, storage, or disposal, any emergency response operations shall comply with paragraph (q) of this section. Compliance with the requirements of paragraph (q) of this section shall be deemed to be in compliance with the requirements of paragraph (p)(8) of this section.

(iv) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraphs (a)(1)(i) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.

(3) Definitions -

"Buddy system" means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

"Clean-up operation" means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

"Decontamination" means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health affects.

"Emergency response" or "responding to emergencies" means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

"***Facility"*** means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

"Hazardous materials response (HAZMAT) team" means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members

perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

"***Hazardous substance"*** means any substance designated or listed under paragraphs (A) through (D) of this definition, exposure to which results or may result in adverse affects on the health or safety of employees:

(A) Any substance defined under section 101(14) of CERCLA;

(B) Any biological agent and other disease causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring.

(C) Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

(D) Hazardous waste as herein defined.

"Hazardous waste" means -

(A) A waste or combination of wastes as defined in 40 CFR 261.3, or

(B) Those substances defined as hazardous wastes in 49 CFR 171.8.

"Hazardous waste operation" means any operation conducted within the scope of this standard.

"Hazardous waste site" or ***"Site"*** means any facility or location within the scope of this standard at which hazardous waste operations take place.

"Health hazard" means a chemical, mixture of chemicals or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, heptaotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to 29 CFR 1926.59.

IDLH" or ***"Immediately dangerous to life or health"*** means an atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

"Oxygen deficiency" means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

"Permissible exposure limit" means the exposure, inhalation or dermal permissible exposure limit specified either in 1926.55, elsewhere in subpart D, or in other pertinent sections of this part.

"***Published exposure level"*** means the exposure limits published in "NIOSH recommendations for Occupational Health Standards" dated 1986 incorporated by reference, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1987 - 88" dated 1987 incorporated by reference.

"Post emergency response" means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer's own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to * paragraph (q)(11) of this section.

"Qualified person" means a person with specific training, knowledge and experience in the area for which the person has the responsibility and the authority to control.

"Site safety and health supervisor (or official)" means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

"Small quantity generator" means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2,205 pounds) of hazardous waste in that month.

"Uncontrolled hazardous waste site" means an area identified as an uncontrolled hazardous waste site by a governmental body, whether Federal, state, local or other where an accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands such as those created by former municipal, county or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous substance wastes. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.

(b) Safety and health program.

Note to (b): Safety and health programs developed and implemented to meet other federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

(1) General.

(i) Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations.

(ii) The written safety and health program shall incorporate the following:

(A) An organizational structure;

(B) A comprehensive workplan;

(C) A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F) of this section;

(D) The safety and health training program;

(E) The medical surveillance program;

(F) The employer's standard operating procedures for safety and health; and

(G) Any necessary interface between general program and site specific activities.

(iii) Site excavation. Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with Subpart P of 29 CFR Part 1926.

(iv) Contractors and sub-contractors. An employer who retains contractor or sub-contractor services for work in hazardous waste operations shall inform those contractors, sub-contractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

(v) Program availability. The written safety and health program shall be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.

(2) Organizational structure part of the site program.

(i) The organizational structure part of the program shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:

(A) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(B) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(C) All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(D) The lines of authority, responsibility, and communication.

(ii) The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.

(3) Comprehensive workplan part of the site program. The comprehensive workplan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those

tasks and objectives.

(i) The comprehensive workplan shall address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere.

(ii) The comprehensive workplan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(iii) The comprehensive workplan shall establish personnel requirements for implementing the plan.

(iv) The comprehensive workplan shall provide for the implementation of the training required in paragraph (e) of this section.

(v) The comprehensive workplan shall provide for the implementation of the required informational programs required in paragraph (i) of this section.

(vi) The comprehensive workplan shall provide for the implementation of the medical surveillance program described in paragraph (f) of this section.

(4) Site-specific safety and health plan part of the program.

(i) General. The site safety and health plan, which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.

(ii) Elements. The site safety and health plan, as a minimum, shall address the following:

(A) A safety and health risk or hazard analysis for each site task and operation found in the workplan.

(B) Employee training assignments to assure compliance with paragraph (e) of this section.

(C) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

(D) Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

(E) Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(F) Site control measures in accordance with the site control program required in paragraph (d) of this section.

(G) Decontamination procedures in accordance with paragraph (k) of this section.

(H) An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(I) Confined space entry procedures.

(J) A spill containment program meeting the requirements of paragraph (j) of this section.

(iii) Pre-entry briefing. The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

(iv) Effectiveness of site safety and health plan. Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

(c) Site characterization and analysis

(1) General. Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

(2) Preliminary evaluation. A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

(3) Hazard identification. All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH) or other conditions that may cause death or serious harm shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

(4) Required information. The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

(i) Location and approximate size of the site.

(ii) Description of the response activity and/or the job task to be performed.

(iii) Duration of the planned employee activity.

(iv) Site topography and accessibility by air and roads.

(v) Safety and health hazards expected at the site.

(vi) Pathways for hazardous substance dispersion.

(vii) Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(viii) Hazardous substances and health hazards involved or expected at the site and their chemical and physical properties.

(5) Personal protective equipment. Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

(i) Based upon the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment.

(ii) If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration shall be carried by employees during initial site entry.

(iii) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(iv) Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

(6) Monitoring. The following monitoring shall be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

(i) Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

(ii) Monitoring the air with appropriate direct reading test equipment for (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances.)

(iii) Visually observing for signs of actual or potential IDLH or other dangerous conditions.

(iv) An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the start-up of operations.

(7) Risk identification. Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1926.59, training required by that standard need not be duplicated.

Note to (c)(7). - Risks to consider include, but are not limited to:

(a) Exposures exceeding the permissible exposure limits and published exposure levels.

(b) IDLH Concentrations.

(c) Potential Skin Absorption and Irritation Sources.

(d) Potential Eye Irritation Sources.

(e) Explosion Sensitivity and Flammability Ranges.

(f) Oxygen deficiency.

(8) Employee notification. Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.

(d) Site control.

(1) General. Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.

(2) Site control program. A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.

(3) Elements of the site control program. The site control program shall, as a minimum, include: A site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.

(e) Training.

(1) General.

(i) All employees working on site (such as but not limited to equipment operators, general laborers and others) exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.

(ii) Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

(2) Elements to be covered. The training shall thoroughly cover the following:

(i) Names of personnel and alternates responsible for site safety and health;

(ii) Safety, health and other hazards present on the site;

(iii) Use of personal protective equipment;

(iv) Work practices by which the employee can minimize risks from hazards;

(v) Safe use of engineering controls and equipment on the site;

(vi) Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards; and

(vii) The contents of paragraphs (G) through (J) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.

(3) Initial training.

(i) General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained experienced supervisor.

(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iii) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iv) Workers with 24 hours of training who are covered by paragraphs * (e)(3)(ii) and (e)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph (e)(3)(i).

(4) Management and supervisor training. On-site management and supervisors directly responsible for or who supervise employees engaged in hazardous waste operations shall receive 40 hours initial training and three days of supervised field experience (the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii)) and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

(5) Qualifications for trainers. Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

(6) Training certification. Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

(7) Emergency response. Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

(8) Refresher training. Employees specified in paragraph (e)(1) of this section, and managers and supervisors specified in paragraph (e)(4) of this section, shall receive eight hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

(9) Equivalent training. Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs * (e)(1) through (e)(4) of this section shall not be required to provide * the initial training requirements of those paragraphs to such employees * and shall provide a copy of the certification or documentation to the * employee upon request. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

(f) Medical surveillance

(1) General. Employers engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (q)(9) shall institute a medical surveillance program in accordance with this paragraph.

(2) Employees covered. The medical surveillance program shall be instituted by the employer for the following employees:

> (i) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;
>
> (ii) All employees who wear a respirator for 30 days or more a year or as required by 1926.103;
>
> (iii) All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and

(iv) Members of HAZMAT teams.

(3) Frequency of medical examinations and consultations. Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

(i) For employees covered under paragraphs (f)(2)(i), (f)(2)(ii), and (f)(2)(iv);

(A) Prior to assignment;

(B) At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(C) At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months.

(D) As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

(E) At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(ii) For employees covered under paragraph (f)(2)(iii) and for all employees including those of employers covered by paragraph (a)(1)(v) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(A) As soon as possible following the emergency incident or development of signs or symptoms;

(B) At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

(4) Content of medical examinations and consultations.

(i) Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

(ii) The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (See Appendix D, reference # 10) should be consulted.

(5) Examination by a physician and costs. All medical examinations and procedures shall be performed by or under the
supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(6) Information provided to the physician. The employer shall provide one copy of this standard and its appendices to the attending physician and in addition the following for each employee:

(i) A description of the employee's duties as they relate to the employee's exposures,

(ii) The employee's exposure levels or anticipated exposure levels.

(iii) A description of any personal protective equipment used or to be used.

(iv) Information from previous medical examinations of the employee which is not readily available to the examining physician.

(v) Information required by 1926.103.

(7) Physician's written opinion.

(i) The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

(A) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

(B) The physician's recommended limitations upon the employee's assigned work.

(C) The results of the medical examination and tests if requested by the employee.

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

(8) Recordkeeping.

(i) An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1926.33.

(ii) The record required in paragraph (f)(8)(i) of this section shall include at least the following information:

(A) The name and social security number of the employee;

(B) Physician's written opinions, recommended limitations and results of examinations and tests;

(C) Any employee medical complaints related to exposure to hazardous substances;

(D) A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

(g) Engineering controls, work practices, and personal protective equipment for employee protection. Engineering controls, work practices and PPE for substances regulated in Subpart Z. (i) Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.

(1) Engineering controls, work practices and PPE for substances regulated either in 1926.55, elsewhere in Subpart D, or in other pertinent sections of this part.

(i) Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated either in 1926.55 or other pertinent sections of this part except to the extent that such controls and practices are not feasible.

Note to (g)(1)(i): Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

(ii) Whenever engineering controls and work practices are not feasible, or not required, any reasonable combination of engineering controls, work practices and PPE shall be used to reduce and maintain employee exposures to or below the permissible exposure limits or dose limits for substances regulated either in 1926.55 or other pertinent sections of this part.

(iii) The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(iv) The provisions of subpart D shall be followed.

(2) Engineering controls, work practices, and PPE for substances not regulated either in 1926.55, elsewhere in subpart D, or in other pertinent sections of the part. An appropriate combination of engineering controls, work practices, and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated either in 1926.55, elsewhere in subpart D, or in other pertinent sections of this part. The employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

(3) Personal protective equipment selection.

(i) Personal protective equipment (PPE) shall be selected and used which will protect employees

from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(ii) Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(iii) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(iv) Totally-encapsulating chemical protective suits (protection equivalent to Level A protection as recommended in Appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(v) The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See Appendix B for guidance on selecting PPE ensembles.)

Note to (g)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(vi) Personal protective equipment shall be selected and used to meet the requirements of subpart E of this part and additional requirements specified in this section.

(4) Totally-encapsulating chemical protective suits.

(i) Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

(ii) Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See Appendix A for a test method which may be used to evaluate this requirement.)

(iii) Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See Appendix A for a test method which may be used to evaluate this requirement.)

(5) Personal protective equipment (PPE) program. A writtten personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(i) PPE selection based upon site hazards,

(ii) PPE use and limitations of the equipment,

(iii) Work mission duration,

(iv) PPE maintenance and storage,

(v) PPE decontamination and disposal,

(vi) PPE training and proper fitting,

(vii) PPE donning and doffing procedures,

(viii) PPE inspection procedures prior to, during, and after use,

(ix) Evaluation of the effectiveness of the PPE program, and

(x) Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

(h) Monitoring.

(1) General.

(i) Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.

(ii) Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

(2) Initial entry. Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres or oxygen-deficient environments.

(3) Periodic monitoring. Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

(i) When work begins on a different portion of the site.

(ii) When contaminants other than those previously identified are being handled.

(iii) When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling.)

(iv) When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon.)

(4) Monitoring of high-risk employees. After the actual clean-up phase of any hazardous waste operation

commences; for example, when soil, surface water or containers are moved or disturbed; the employer shall monitor those employees likely to have the highest exposures to those hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated in the first sentence of this paragraph. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure limits, then monitoring shall continue to determine all employees likely to be above those limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated above.

Note to (h): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

(i) Informational programs. Employers shall develop and implement a program which is part of the employer's safety and health program required in paragraph (b) of this section to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

(j) Handling drums and containers

(1) General.

(i) Hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

(ii) Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

(iii) When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

(iv) Unlabelled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(v) Site operations shall be organized to minimize the amount of drum or container movement.

(vi) Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

(vii) U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.

(viii) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(ix) Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.

(x) A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(xi) Soil or covering material shall be removed with caution to prevent drum or container rupture.

(xii) Fire extinguishing equipment meeting the requirements of subpart F of this part shall be on hand and ready for use to control incipient fires.

(2) Opening drums and containers. The following procedures shall be followed in areas where drums or containers are being opened:

(i) Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.

(ii) Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.

(iii) If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(iv) Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.

(v) When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools shall be of the type to prevent sources of ignition.

(vi) Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure cannot be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(vii) Employees shall not stand upon or work from drums or containers.

(3) Material handling equipment. Material handling equipment used to transfer drums and containers shall be selected, positioned
and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

(4) Radioactive wastes. Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

(5) Shock sensitive wastes. As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(i) All non-essential employees shall be evacuated from the area of transfer.

(ii) Material handling equipment shall be provided with explosive containment devices or protective

shields to protect equipment operators from exploding containers.

(iii) An employee alarm system capable of being perceived above surrounding light and noise conditions shall be used to signal the commencement and completion of explosive waste handling activities.

(iv) Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

(v) Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(vi) Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: Shipping of shock sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

(6) Laboratory waste packs. In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):

(i) Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(ii) If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

(7) Sampling of drum and container contents. Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.

(8) Shipping and transport.

(i) Drums and containers shall be identified and classified prior to packaging for shipment.

(ii) Drum or container staging areas shall be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(iii) Staging areas shall be provided with adequate access and egress routes.

(iv) Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.

(9) Tank and vault procedures.

(i) Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for

drums and containers, taking into consideration the size of the tank or vault.

(ii) Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.

(k) Decontamination

(1) General. Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

(2) Decontamination procedures.

(i) A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

(ii) Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(iii) All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

(iv) Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

(3) Location. Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

(4) Equipment and solvents. All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

(5) Personal protective clothing and equipment.

(i) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(ii) Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(6) Unauthorized employees. Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(7) Commercial laundries or cleaning establishments. Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

(8) Showers and change rooms. Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29

CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

(l) Emergency response by employees at uncontrolled hazardous waste sites

(1) Emergency response plan.

(i) An emergency response plan shall be developed and implemented by all employers within the scope of paragraphs (a)(1)(i) - (ii) of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(ii) Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with section 1926.35 of this part.

(2) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

(i) Pre-emergency planning.

(ii) Personnel roles, lines of authority, training, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination procedures which are not covered by the site safety and health plan.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(3) Procedures for handling emergency incidents.

(i) In addition to the elements for the emergency response plan required in paragraph (l)(2) of this section, the following elements shall be included for emergency response plans:

(A) Site topography, layout, and prevailing weather conditions.

(B) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(iii) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(iv) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(v) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(vi) An employee alarm system shall be installed in accordance with 29 CFR 1926.159 to notify employees of an emergency situation, to stop work activities if necessary, to lower background noise in order to speed communication, and to begin emergency procedures.

(vii) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(m) Illumination. Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table D-65.1 while any work is in progress:

TABLE D-65.1
MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES

Foot-candles	Area or operations
5	General site areas.
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas; (Exception: minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.
30	First aid stations, infirmaries, and offices.

(n) Sanitation at temporary workplaces

(1) Potable water.

(i) An adequate supply of potable water shall be provided on the site.

(ii) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(iii) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(iv) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(2) Nonpotable water.

(i) Outlets for nonpotable water, such as water for firefighting purposes shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(3) Toilet facilities.

(i) Toilets shall be provided for employees according to Table D-65.2.

TABLE D-65.2
TOILET FACILITIES

Number of employees	Minimum number of facilities
20 or fewer	One.
More than 20, fewer than 200.	One toilet seat and 1 urinal per 40 employees.
More than 200	One toilet seat and 1 urinal per 50 employees.

(ii) Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available.

(iii) Hazardous waste sites, not provided with a sanitary sewer, shall be provided with the following toilet facilities unless prohibited by local codes:

(A) Chemical toilets;

(B) Recirculating toilets;

(C) Combustion toilets; or

(D) Flush toilets.

(iv) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(v) Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

(4) Food handling. All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(5) Temporary sleeping quarters. When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(6) Washing facilities. The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

(7) Showers and change rooms. When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(i) Showers shall be provided and shall meet the requirements of 29 CFR 1926.51(f)(4).

(ii) Change rooms shall be provided and shall meet the requirements of 29 CFR 1926.51(i). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(iii) Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(iv) Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

(o) New technology programs.

(1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminates while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request. * (p) Certain Operations Conducted Under the Resource Conservation and * Recovery Act of 1976 (RCRA). Employers conducting operations at * treatment, storage and disposal (TSD) facilities specified in paragraph * (a)(1)(iv) of this section shall provide and implement the programs * specified in this paragraph. See the "Notes and Exceptions" to paragraph * (a)(2)(iii) of this section for employers not covered.

(p) Certain operations conducted under the Resource Conservation and Recovery Act of 1976 (RCRA). Employers conducting operations at treatment, storage and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section shall provide and implement the programs specified in this paragraph. See the "Notes and Exceptions" to paragraph (a)(2)(iii) of this section for employers not covered.).

(1) Safety and health program. The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

(2) Hazard communication program. The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1926.59 as part of the employer's safety and program.

Note to 1926.65 - The exemption for hazardous waste provided in 1926.59 is applicable to this section.

(3) Medical surveillance program. The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

(4) Decontamination program. The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

(5) New technology program. The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

(6) Material handling program. Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1)(ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

(7) Training program

> (i) New employees. The employer shall develop and implement a training program which is part of the employer's safety and * health program, for employees exposed to health hazards or hazardous * substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who

have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(ii) Current employees. Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

(iii) Trainers. Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

(8) Emergency response program

(i) Emergency response plan. An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employers safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with section 1926.35 of this part.

(ii) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(A) Pre-emergency planning and coordination with outside parties.

(B) Personnel roles, lines of authority, training, and communication.

(C) Emergency recognition and prevention.

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures.

(H) Emergency medical treatment and first aid.

(I) Emergency alerting and response procedures.

(J) Critique of response and follow-up.

(K) PPE and emergency equipment.

(iii) Training.

(A) Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

Exception #1: an employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

Exception #2: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

(B) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over exposures.

(C) The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(iv) Procedures for handling emergency incidents.

(A) In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(1) Site topography, layout, and prevailing weather conditions.

(2) Procedures for reporting incidents to local, state, and federal governmental agencies.

(B) The emergency response plan shall be compatible and integrated with the disaster, fire

and/or emergency response plans of local, state, and federal agencies.

(C) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(D) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(E) An employee alarm system shall be installed in accordance with 29 CFR 1926.159 to notify employees of an emergency situation, to stop work activities if necessary, to lower background noise in order to speed communication; and to begin emergency procedures.

(F) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(q) Emergency response to hazardous substance releases. This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

(1) Emergency response plan. An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives and OSHA personnel. Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with section 1926.35 of this part.

(2) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(i) Pre-emergency planning and coordination with outside parties.

(ii) Personnel roles, lines of authority, training, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(xii) Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

(3) Procedures for handling emergency response.

(i) The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

Note to (q)(3)(i). - The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e. , battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

(ii) The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

(iii) Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1926.97 when worn while performing fire fighting operations beyond the incipient stage for any incident.

(iv) Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

(v) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.
(vi) Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Advance first aid support personnel, as a minimum, shall also stand by with medical equipment and transportation capability.

(vii) The individual in charge of the ICS shall designate a safety official, who is knowledgeable in the

operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(viii) When activities are judged by the safety official to be an IDLH and/or to involve an imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the * ICS of any actions needed to be taken to correct these hazards at the emergency scene.

(ix) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(x) When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

(4) Skilled support personnel. Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

(5) Specialist employees. Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

(6) Training. Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(i) First responder awareness level. First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(A) An understanding of what hazardous substances are, and the risks associated with them in an incident.

(B) An understanding of the potential outcomes associated with an emergency created when

hazardous substances are present.

(C) The ability to recognize the presence of hazardous substances in an emergency.

(D) The ability to identify the hazardous substances, if possible.

(E) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(F) The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(ii) First responder operations level. First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level.

(C) An understanding of basic hazardous materials terms.

(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(E) Know how to implement basic decontamination procedures.

(F) An understanding of the relevant standard operating procedures and termination procedures.

(iii) Hazardous materials technician. Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the employer's emergency response plan.

(B) Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(C) Be able to function within an assigned role in the Incident Command System.

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination procedures.

(H) Understand termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior.

(iv) Hazardous materials specialist. Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regards to site activities. Hazardous materials specialists shall have competency in the following areas and the employer shall so certify:

(A) Know how to implement the local emergency response plan.

(B) Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

(C) Of the state emergency response plan.

(D) Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(E) Understand in-depth hazard and risk techniques.

(F) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(G) Be able to determine and implement decontamination procedures.

(H) Have the ability to develop a site safety and control plan.

(I) Understand chemical, radiological and toxicological terminology and behavior.

(v) On scene incident commander. Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know and be able to implement the employer's incident command system.

(B) Know how to implement the employer's emergency response plan.

(C) Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(D) Know how to implement the local emergency response plan.

(E) Know of the state emergency response plan and of the Federal Regional Response Team.

(F) Know and understand the importance of decontamination procedures.

(7) Trainers. Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the * U.S. National Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

(8) Refresher training.

(i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

(9) Medical surveillance and consultation.

(i) Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

(ii) Any emergency response employees who exhibits signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident, either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

(10) Chemical protective clothing. Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g)(3) through (5) of this section.

(11) Post-emergency response operations. Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

(i) Meet all the requirements of paragraphs (b) through (o) of this section; or

(ii) Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1926.35; 1926.59; 1926.103, and other appropriate safety and health training made necessary by the tasks that they are expected to be performed such as personal protective equipment and decontamination

procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use.

NOTE: The following appendices serve as non-mandatory guidelines to assist employees and employers in complying with the appropriate requirements of this section. However 1926.65(g) makes mandatory in certain circumstances the use of Level A and Level B PPE protection.

Appendix A

Personal Protective Equipment Test Methods

This appendix sets forth the non-mandatory examples of tests which may be used to evaluate compliance with 1926.65(g)(4) (ii) and (iii). Other tests and other challenge agents may be used to evaluate compliance.

A. Totally-Encapsulating chemical protective suit pressure test

1.0 - Scope

1.1 This practice measures the ability of a gas tight totally-encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas tight integrity of a totally-encapsulating chemical protective suit to be evaluated.

1.2 Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

2.0 - Definition of Terms

2.1 "Totally-encapsulated chemical protective suit (TECP suit)" means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

2.2 "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 "Gas tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

3.0 - Summary of test method

3.1 The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pre-test suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for three minutes. If the pressure drop is excessive, the TECP suit fails the test and is removed from service. The test is repeated after leak location and repair.

4.0 - Required Supplies

4.1 Source of compressed air.

4.2 Test apparatus for suit testing including a pressure measurement device with a sensitivity of at least 1/4 inch water gauge.

4.3 Vent valve closure plugs or sealing tape.

4.4 Soapy water solution and soft brush.

4.5 Stop watch or appropriate timing device.

5.0 - Safety Precautions

5.1 Care shall be taken to provide the correct pressure safety devices required for the source of compressed air used.

6.0 - Test Procedure

6.1 Prior to each test, the tester shall perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

6.1.1 Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or face piece opening) with tape or other appropriate means (caps, plugs, fixture, etc.). Care should be exercised in the sealing process not to damage any of the suit components.

6.1.2 Close all closure assemblies.

6.1.3 Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of three inches water gauge for three minutes can be maintained. If a component is removed for the test, that component shall be replaced and a second test conducted with another component removed to permit a complete test of the ensemble.

6.1.4 The pre-test expansion pressure (A) and the suit test pressure (B) shall be supplied by the suit manufacturer, but in no case shall they be less than: (A) = three inches water gauge and (B) = two inches water gauge. The ending suit pressure (C) shall be no less than 80 percent of the test pressure (B); i.e., the pressure drop shall not exceed 20 percent of the test pressure (B).

6.1.5 Inflate the suit until the pressure inside is equal to pressure (A), the pre-test expansion suit pressure. Allow at least one minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of three minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B - C) shall be defined as the suit pressure drop.

6.1.6 If the suit pressure drop is more than 20 percent of the suit test pressure (B) during the three minute test period, the suit fails the test and shall be removed from service.

7.0 - Retest Procedure

7.1 If the suit fails the test check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water

solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

7.2 Retest the TECP suit as outlined in Test procedure 6.0.

8.0 - Report

8.1 Each TECP suit tested by this practice shall have the following information recorded.

8.1.1 Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features; e.g., special breathing apparatus.

8.1.2 The actual values for test pressures,(A), (B), and (C) shall be recorded along with the specific observation times. If the ending pressure (C) is less than 80 percent of the test pressure (B), the suit shall be identified as failing the test. When possible, the specific leak location shall be identified in the test records. Retest pressure data shall be recorded as an additional test.

8.1.3 The source of the test apparatus used shall be identified and the sensitivity of the pressure gauge shall be recorded.

8.1.4 Records shall be kept for each pressure test even if repairs are being made at the test location.
Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

B. Totally-encapsulating chemical protective suit qualitative leak test

1.0 - Scope

1.1 This practice semi-qualitatively tests gas tight totally-encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

1.2 Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for these characteristics and the tests are usually conducted by the manufacturers of the suits.

2.0 - Definition of Terms

2.1 "Totally-encapsulated chemical protective suit (TECP suit)" means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves, and boots.

2.2 "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

2.3 "Gas tight" means, for the purpose of this test method the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

2.4 "Intrusion Coefficient" means a number expressing the level of protection provided by a gas tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient the greater the protection provided by the TECP suit.

3.0 - Summary of recommended practice

3.1 The volume of concentrated aqueous ammonia solution (ammonia hydroxide, NH(4) OH) required to generate the test atmosphere is determined using the directions outlined in 6.1. The suit is donned by a person wearing the appropriate respiratory equipment (either a self-contained breathing apparatus or a supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A two-minute evaporation period is observed before the test room concentration is measured using a high range ammonia length of stain detector tube. When the ammonia vapor reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed the test room concentration is measured again. The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure, aid the person in donning and doffing the TECP suit; and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test area concentration by the interior suit concentration. A colorimetric indicator strip of bromophenol blue is placed on the inside of the suit face piece lens so that the suited individual is able to detect a color change and know if the suit has a significant leak. If a color change is observed the individual shall leave the test room immediately.

4.0 - Required supplies * 4.1 A supply of concentrated aqueous ammonium hydroxide (58% by weight).

4.2 A supply of bromophenol/blue indicating paper, sensitive to 5-10 ppm ammonia or greater over a two-minute period of exposure.[pH 3.0(yellow) to pH 4.6(blue)]

4.3 A supply of high range (0.5 - 10 volume percent) and low range (5 - 700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

4.4 A plastic pan (PVC) at least 12":14":1" and a half pint plastic container (PVC) with tightly closing lid.

4.5 A graduated cylinder or other volumetric measuring device of at least 50 milliliters in volume with an accuracy of at least + or - 1 milliliters.

5.0 - Safety precautions

5.1 Concentrated aqueous ammonium hydroxide, NH(4)OH, is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting test shall review the MSDS for aqueous ammonia. *

5.2 Since the established permissible exposure limit for ammonia is 35 ppm as a 15 minute STEL, only persons wearing a positive pressure self-contained breathing apparatus or a supplied air respirator shall be in the chamber. Normally only the person wearing the total-encapsulating suit will be inside the chamber. A stand-by person shall have a positive pressure self-contained breathing apparatus, or a supplied air respirator, available to enter the test area should the suited individual need assistance.

5.3 A method to monitor the suited individual must be used during this test. Visual contact is the simplest but other methods using communication devices are acceptable.

5.4 The test room shall be large enough to allow the exercise protocol to be carried out and and then to be ventilated to allow for easy exhaust of the ammonia test atmosphere after the test(s) are completed.

5.5 Individuals shall be medically screened for the use of respiratory protection and checked for allergies to ammonia before participating in this test procedure.

6.0 - Test procedure

6.1.1 Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia solution per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

6.1.2 Measure this volume from the supply of concentrated ammonia and place it into a closed plastic container.

6.1.3 Place the container, several high range ammonia detector tubes, and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

6.2.1 In a non-contaminated atmosphere, open a pre-sealed ammonia indicator strip and fasten one end of the strip to the inside of suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care shall be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

6.2.2 If problems are encountered with this method of attachment, the indicator strip can be attached to the outside of the respirator face piece being used during the test.

6.3 Don the respiratory protective device normally used with the suit, and then don the TECP suit to be tested. Check to be sure all openings which are intended to be sealed (zippers, gloves, etc.) are completely sealed. DO NOT, however, plug off any venting valves.

6.4 Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

6.5 Open the container with the pre-measured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait two minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of ammonia solution.

6.6 After two minutes a determination of the ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater shall be

generated before the exercises are started.

6.7 To test the integrity of the suit the following four minute exercise protocol should be followed:

6.7.1 Raising the arms above the head with at least 15 raising motions completed in one minute.

6.7.2 Walking in place for one minute with at least 15 raising motions of each leg in a one-minute period.

6.7.3 Touching the toes with a least 10 complete motions of the arms from above the head to touching of the toes in a one-minute period.

6.7.4 Knee bends with at least 10 complete standing and squatting motions in a one-minute period.

6.8 If at any time during the test the colorimetric indicating paper should change colors, the test should be stopped and section 6.10 and 6.12 initiated (See 4.2).

6.9 After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

6.10 Exit the test area.

6.11 The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough from the enclosed test area to prevent a false ammonia reading.

6.12 After completion of the measurement of the suit interior ammonia concentration the test is concluded and the suit is doffed and the respirator removed.

6.13 The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan shall be vented to the outside of the building.

6.14 Any detectable ammonia in the suit interior (five ppm (NH(3)) or more for the length of stain detector tube) indicates the suit has failed the test. When other ammonia detectors are used a lower level of detection is possible, and it should be specified as the pass/fail criteria.

6.15 By following this test method, an intrusion coefficient of approximately 200 or more can be measured with the suit in a completely operational condition. If the coefficient is 200 or more, then the suit is suitable for emergency response and field use.

7.0 - Retest procedures

7.1 If the suit fails this test, check for leaks by following the pressure test in test A above.

7.2 Retest the TECP suit as outlined in the test procedure 6.0.

8.0 - Report

8.1 Each gas tight totally-encapsulating chemical protective suit tested by this practice shall have the following information recorded.

8.1.1 Unique identification number identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

8.1.2 General description of test room used for test.

8.1.3 Brand name and purchase date of ammonia detector strips and color change data.

8.1.4 Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

8.1.5 Actual test results shall list the two test area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Retest data shall be recorded as an additional test.

8.2 The evaluation of the data shall be specified as "suit passed" or "suit failed," and the date of the test. Any detectable ammonia (five ppm or greater for the length of stain detector tube) in the suit interior indicates the suit has failed this test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass fail criteria.

Caution

Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

Appendix B

General Description and Discussion of the Levels of Protection and Protective Gear

This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employers in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations.

Other factors in this selection process to be considered are matching the PPE to the employee's work

requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks . The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor can make decisions to up-grade or down-grade the level of PPE protection to match the tasks at hand.

The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and re-selection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

Part A. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

I. Level A - To be selected when the greatest level of skin, respiratory, and eye protection is required.

The following constitute Level A equipment; it may be used as appropriate;

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).

2. Totally-encapsulating chemical-protective suit.

3. Coveralls.(1)

4. Long underwear.(1)

5. Gloves, outer, chemical-resistant.

6. Gloves, inner, chemical-resistant.

7. Boots, chemical-resistant, steel toe and shank.

8. Hard hat (under suit).(1)

9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit). FOOTNOTE(1) Optional, as applicable.

II. Level B - The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.

The following constitute Level B equipment; it may be used as appropriate.

1. Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).

2. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls.(1)

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.

6. Boots, outer, chemical-resistant steel toe and shank.

7. Boot-covers, outer, chemical-resistant (disposable).(1)

8. Hard hat.(1)

9. [Reserved]

10. Face shield.

III. Level C - The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

The following constitute Level C equipment; it may be used as appropriate.

1. Full-face or half-mask, air purifying respirators (NIOSH approved).

2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls.(1)

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.

6. Boots (outer), chemical-resistant steel toe and shank.(1)

7. Boot-covers, outer, chemical-resistant (disposable).(1)

(disposable)
8. Hard hat.(1)

9. Escape mask.(1)

10. Face shield.(1)

IV. Level D - A work uniform affording minimal protection: used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.

2. Gloves.(1)

3. Boots/shoes, chemical-resistant steel toe and shank.

4. Boots, outer, chemical-resistant (disposable).(1)

5. Safety glasses or chemical splash goggles.(1)

6. Hard hat.(1)

7. Escape mask.(1)

8. Face shield.(1)

Part B. The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

I. Level A - Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the skin,

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

3. Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

II. Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection.

2. The atmosphere contains less than 19.5 percent oxygen; or

3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. Level C - Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;

2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

3. All criteria for the use of air-purifying respirators are met.

IV. Level D - Level D protection should be used when:
1. The atmosphere contains no known hazard; and

2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Note: As stated before, combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association is developing standards on chemical protective clothing. These standards are currently undergoing public review prior to adoption, including:

NFPA 1991 - Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing) * NFPA 1992 - Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing) NFPA 1993 - Standard on Liquid Splash-Protective Suits for Non-emergency. Non-flammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standards would apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements would be labeled as compliant with the appropriate standard. When these standards are adopted by the National Fire Protection Association, it is recommended that chemical protective suits which meet these standards be used.

Appendix C
Compliance Guidelines

1. Occupational Safety and Health Program. Each hazardous waste site clean-up effort will require an occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on

the site and implemented as work proceeds as stated in paragraph (b). The program is to facilitate coordination and communication of safety and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling worksite hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employers manager on site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have its own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor.

Also those employers involved with treating, storing or disposal of hazardous waste as covered in paragraph (p) must have implemented a safety and health program for their employees. This program is to include the hazard communication program required in paragraph (p)(1) and the training required in paragraphs (p)(7) and (p)(8) as parts of the employers comprehensive overall safety and health program. This program is to be in writing.

Each site or workplace safety and health program will need to include the following: (1) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health supervisor or manager and staff; (2) means or methods for the development of procedures for identifying and controlling workplace hazards at the site; (3) means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors; (4) means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner; (5) means to anticipate and prepare for emergency situations and; (6) means for obtaining information feedback to aid in evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

Accidents on the site or workplace should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illnesses occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified Safety Professionals, Board Certified Industrial Hygienists or Registered Professional Safety Engineers are good examples of professional stature for safety and health managers who will administer the employer's program.

2. Training. The training programs for employees subject to the requirements of paragraph (e) of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean-up sites; what control measures or techniques are effective for those hazards; what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standard relevant to the employee's duties and function; and employee's responsibilities under OSHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject

areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

The training programs for employees subject to the requirements of paragraph (p) of this standard should address: the employer's safety and health program elements impacting employees; the hazard communication program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

The training programs for employees covered by the requirements of paragraph (q) of this standard should address those competencies required for the various levels of response such as: the hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including respirators; the decontamination procedures to be used; preplanning activities for hazardous substance incidents including the emergency response plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include an evaluation of what worked and what did not and how could the incident be better handled the next time may be counted as training time.

For hazardous materials specialists (usually members of hazardous materials teams), the training should address the care, use and/or testing of chemical protective clothing including totally encapsulating suits, the medical surveillance program, the standard operating procedures for the hazardous materials team including the use of plugging and patching equipment and other subject areas.

Officers and leaders who may be expected to be in charge at an incident should be fully knowledgeable of their company's incident command system. They should know where and how to obtain additional assistance and be familiar with the local district's emergency response plan and the state emergency response plan.

Specialist employees such as technical experts, medical experts or environmental experts that work with hazardous materials in their regular jobs, who may be sent to the incident scene by the shipper, manufacturer or governmental agency to advise and assist the person in charge of the incident should have training on an annual basis. Their training should include the care and use of personal protective equipment including respirators; knowledge of the incident command system and how they are to relate to it; and those areas needed to keep them current in their respective field as it relates to safety and health involving specific hazardous substances.

Those skilled support personnel, such as employees who work for public works departments or equipment operators who operate bulldozers, sand trucks, backhoes, etc., who may be called to the incident scene to provide emergency support assistance, should have at least a safety and health briefing before entering the area of potential or actual exposure. These skilled support personnel, who have not been a part of the emergency response plan and do not meet the training requirements, should be made aware of the hazards they face and should be provided all necessary protective clothing and equipment required for their tasks. * There are two National Fire Protection Association standards. NFPA 472 - "Standard for Professional Competence of Responders to Hazardous Material Incidents" and NFPA 471 - "Recommended Practice for Responding to Hazardous Material Incidents", which are excellent resource documents to aid fire departments and other emergency response organizations in developing their training program materials. NFPA 472 provides guidance on the skills and knowledge needed for first responder awareness level, first responder operations level, hazmat technicians, and hazmat specialist. It also offers guidance for the officer corp who will be in charge of hazardous substance incidents.

3. Decontamination. Decontamination procedures should be tailored to the specific hazards of the site and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure

to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees * are not exposed to hazards by reusing PPE. References in Appendix D may be used for guidance in establishing an effective decontamination program. In addition, the U.S.Coast Guard's Manual, "Policy Guidance for Response to Hazardous Chemical Releases," U.S. Department of Transportation, Washington, DC (COMDTINST M16465.30) is a good reference for establishing an effective decontamination program.

4. Emergency response plans. States, along with designated districts within the states, will be developing or have developed emergency response plans. These state and district plans should be utilized in the emergency response plans called for in the standard. Each employer should assure that its emergency response plan is compatible with the local plan. The major reference being used to aid in developing the state and local district plans is the Hazardous Materials Emergency Planning Guide, NRT - 1. The current Emergency Response Guidebook from the U.S. Department of Transportation, CMA's CHEMTREC and the Fire Service Emergency Management Handbook may also be used as resources.

Employers involved with treatment, storage, and disposal facilities for hazardous waste, which have the required contingency plan called for by their permit, would not need to duplicate the same planning elements. Those items of the emergency response plan may be substituted into the emergency response plan required in 1926.65 or otherwise kept together for employer and employee use.

5. Personal protective equipment programs. The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous substance site.

As discussed in Appendix B, no single combination of protective equipment and clothing is capable of protecting against all hazards. Thus PPE should be used in conjunction with other protective methods and its effectiveness evaluated periodically.

The use of PPE can itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility and communication. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. However, over-protection, as well as under-protection, can be hazardous and should be avoided where possible. Two basic objectives of any PPE program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include hazard identification, medical monitoring, environmental surveillance, selection, use, maintenance, and decontamination of PPE and its associated training.

The written PPE program should include policy statements, procedures, and guidelines. Copies should be made available to all employees, and a reference copy should be made available at the worksite. Technical data on equipment, maintenance manuals, relevant regulations, and other essential information should also be collected and maintained.

6. Incident command system (ICS). Paragraph 1926.65(q)(3)(ii) requires the implementation of an ICS. The ICS is an organized approach to effectively control and manage operations at an emergency incident. The individual in charge of the ICS is the senior official responding to the incident. The ICS is not much different than the "command post" approach used for many years by the fire service. During large complex fires involving several companies and many pieces of apparatus, a command post would be established. This enabled one individual to be in charge of managing the incident, rather than having several officers from different companies making separate, and sometimes conflicting, decisions. The individual in charge of the command post would delegate responsibility for performing various tasks to subordinate officers.

Additionally, all communications were routed through the command post to reduce the number of radio transmissions and eliminate confusion. However, strategy, tactics, and all decisions were made by one individual.

The ICS is a very similar system, except it is implemented for emergency response to all incidents, both large and small, that involve hazardous substances.

For a small incident, the individual in charge of the ICS may perform many tasks of the ICS. There may not be any, or little, delegation of tasks to subordinates. For example, in response to a small incident, the individual in charge of the ICS, in addition to normal command activities, may become the safety officer and may designate only one employee (with proper equipment) as a backup to provide assistance if needed. OSHA does recommend, however, that at least two employees be designated as back-up personnel since the assistance needed may include rescue.

To illustrate the operation of the ICS, the following scenario might develop during a small incident, such as an overturned tank truck with a small leak of flammable liquid.

The first responding senior officer would implement and take command of the ICS. That person would size-up the incident and determine if additional personnel and apparatus were necessary; would determine what actions to take to control the leak; and determine the proper level of personal protective equipment. If additional assistance is not needed, the individual in charge of the ICS would implement actions to stop and control the leak using the fewest number of personnel that can effectively accomplish the tasks. The individual in charge of the ICS then would designate himself as the safety officer and two other employees as a back-up in case rescue may become necessary. In this scenario, decontamination procedures would not be necessary.

A large complex incident may require many employees and difficult, time-consuming efforts to control. In these situations, the individual in charge of the ICS will want to delegate different tasks to subordinates in order to maintain a span of control that will keep the number of subordinates, that are reporting, to a manageable level.

Delegation of task at large incidents may be by location, where the incident scene is divided into sectors, and subordinate officers coordinate activities within the sector that they have been assigned.

Delegation of tasks can also be by function. Some of the functions that the individual in charge of the ICS may want to delegate at a large incident are: medical services; evacuation; water supply; resources (equipment, apparatus); media relations; safety; and, site control (integrate activities with police for crowd and traffic control). Also for a large incident, the individual in charge of the ICS will designate several employees as back-up personnel; and a number of safety officers to monitor conditions and recommend safety precautions.

Therefore, no matter what size or complexity an incident may be, by implementing an ICS there will be one individual in charge who makes the decisions and gives directions; and, all actions, and communications are coordinated through one central point of command. Such a system should reduce confusion, improve safety, organize and coordinate actions, and should facilitate effective management of the incident.

7. Site Safety and Control Plans. The safety and security of response personnel and others in the area of an emergency response incident site should be of primary concern to the incident commander. The use of a site safety and control plan could greatly assist those in charge of assuring the safety and health of employees on the site.

A comprehensive site safety and control plan should include the following: summary analysis of hazards on the site and a risk analysis of those hazards; site map or sketch; site work zones (clean zone, transition or decontamination zone, work or hot zone); use of the buddy system; site communications; command post or command center; standard operating procedures and safe work practices; medical assistance and triage area; hazard monitoring plan (air contaminate monitoring, etc.); decontamination procedures and area; and other relevant areas. This plan should be a part of the employer's emergency response plan or an extension of it to the specific site.

8. Medical surveillance programs. Workers handling hazardous substances may be exposed to toxic chemicals, safety hazards, biologic hazards, and radiation. Therefore, a medical surveillance program is essential to assess and monitor workers' health and fitness for employment in hazardous waste operations and during the course of work; to provide emergency and other treatment as needed; and to keep accurate records for future reference.

The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA); October 1985 provides an excellent example of the types of medical testing that should be done as part of a medical surveillance program. * 9. New Technology and Spill Containment Programs. Where hazardous substances may be released by spilling from a container that will expose employees to the hazards of the materials, the employer will need to implement a program to contain and control the spilled material. Diking and ditching, as well as use of absorbents like diatomaceous earth, are traditional techniques which have proven to be effective over the years. However, in recent years new products have come into the marketplace, the use of which complement and increase the effectiveness of these traditional methods. These new products also provide emergency responders and others with additional tools or agents to use to reduce the hazards of spilled materials.

These agents can be rapidly applied over a large area and can be uniformly applied or otherwise can be used to build a small dam, thus improving the workers' ability to control spilled material. These application techniques enhance the intimate contact between the agent and the spilled material allowing for the quickest effect by the agent or quickest control of the spilled material. Agents are available to solidify liquid spilled materials, to suppress vapor generation from spilled materials, and to do both. Some special agents, which when applied as recommended by the manufacturer, will react in a controlled manner with the spilled material to neutralize acids or caustics, or greatly reduce the level of hazard of the spilled material.

There are several modern methods and devices for use by emergency response personnel or others involved with spill control efforts to safely apply spill control agents to control spilled material hazards. These include portable pressurized applicators similar to hand-held portable fire extinguishing devices, and nozzle and hose systems similar to portable fire fighting foam systems which allow the operator to apply the agent without having to come into contact with the spilled material. The operator is able to apply the agent to the spilled material from a remote position.

The solidification of liquids provides for rapid containment and isolation of hazardous substance spills. By directing the agent at run-off points or at the edges of the spill, the reactant solid will automatically create a barrier to slow or stop the spread of the material. Clean-up of hazardous substances is greatly improved when solidifying agents, acid or caustic neutralizers, or activated carbon adsorbents are used. properly applied, these agents can totally solidify liquid hazardous substances or neutralize or absorb them, which results in materials which are less hazardous and easier to handle, transport, and dispose of. The concept of spill treatment, to create less hazardous substances, will improve the safety and level of protection of employees working at spill clean-up operations or emergency response operations to spills of hazardous substances.

The use of vapor suppression agents for volatile hazardous substances, such as flammable liquids and those substances, such as flammable liquids and those substances which present an inhalation hazard, is important for protecting workers. The rapid and uniform distribution of the agent over the surface of the spilled material can provide quick vapor knockdown. There are temporary and long-term foam-type agents which are effective on vapors and dusts, and activated carbon adsorption agents which are effective for vapor control

and soaking-up of the liquid. The proper use of hose lines or hand-held portable pressurized applicators provides good mobility and permits the worker to deliver the agent from a safe distance without having to step into the untreated spilled material. Some of these systems can be recharged in the field to provide coverage of larger spill areas than the design limits of a single charged applicator unit. Some of the more effective agents can solidify the liquid flammable hazardous substances and at the same time elevate the flashpoint above 140 degrees F so the resulting substance may be handled as a nonhazardous waste material if it meets the U.S. Environmental Protection Agency's 40 CFR part 261 requirements (See particularly 261.21).

All workers performing hazardous substance spill control work are expected to wear the proper protective clothing and equipment for the materials present and to follow the employer's established standard operating procedures for spill control. All involved workers need to be trained in the established operating procedures; in the use and care of spill control equipment; and in the associated hazards and control of such hazards of spill containment work.

These new tools and agents are the things that employers will want to evaluate as part of their new technology program. The treatment of spills of hazardous substances or wastes at an emergency incident as part of the immediate spill containment and control efforts is sometimes acceptable to EPA and a permit exception is described in 40 CFR 264.1(g)(8) and 265.1(c)(11).

Appendix D
References

The following references may be consulted for further information on the subject of this standard:

1. OSHA Instruction DFO CPL 2.70 - January 29, 1986, Special Emphasis Program: Hazardous Waste Sites.

2. OSHA Instruction DFO CPL 2-2.37A - January 29, 1986, Technical Assistance and Guidelines for Superfund and Other Hazardous Waste Site Activities.

3. OSHA Instruction DTS CPL 2.74 - January 29, 1986, Hazardous Waste Activity Form, OSHA 175.

4. Hazardous Waste Inspections Reference Manual, U.S. Department of Labor, Occupational Safety and Health Administration, 1986.

5. Memorandum of Understanding Among the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the United States Coast Guard, and the United States Environmental Protection Agency, Guidance for Worker Protection During Hazardous Waste Site Investigations and Clean-up and Hazardous Substance Emergencies. December 18, 1980.

6. National Priorities List, 1st Edition, October 1984; U.S. Environmental Protection Agency, Revised periodically.

7. The Decontamination of Response Personnel, Field Standard Operating Procedures (F.S.O.P.) 7; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, December 1984.

8. Preparation of a Site Safety Plan, Field Standard Operating Procedures (F.S.O.P.) 9; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, April 1985.

9. Standard Operating Safety Guidelines; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team; November 1984.

10. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA); October 1985.

11. Protecting Health and Safety at Hazardous Waste Sites: An Overview, U.S. Environmental Protection Agency, EPA/625/9-85/006; September 1985.

12. Hazardous Waste Sites and Hazardous Substance Emergencies, NIOSH Worker Bulletin, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; December 1982.

13. Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; October 1984.

14. Fire Service Emergency Management Handbook, Federal Emergency Management Agency, Washington, DC, January 1985.

15. Emergency Response Guidebook, U.S. Department of Transportation, Washington, DC, 1987.

16. Report to the Congress on Hazardous Materials Training. Planning and Preparedness, Federal Emergency Management Agency, Washington, DC, July 1986.

17. Workbook for Fire Command, Alan V.Brunacini and J. David Beageron, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269, 1985.

18. Fire Command, Alan B. Brunacini, National Fire Protection * Association, Batterymarch Park, Quincy, MA 02269, 1985.

19. Incident Command System, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078, 1983.

20. Site Emergency Response Planning, Chemical Manufacturers Association, Washington, DC 20037, 1986.

21. Hazardous Materials Emergency Planning Guide, NRT-1, Environmental Protection Agency, Washington, DC, March 1987.

22. Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety. U.S. Department of Transportation, Washington, DC, May 1983.

23. Disaster Planning Guide for Business and Industry, Federal Emergency Management Agency, Publication No. FEMA 141, August 1987.

(The Office of Management and Budget has approved the information collection requirements in this section under control number 1218-0139)

29 CFR 1926.66
SPRAY FINISHING USING FLAMMABLE AND COMBUSTIBLE MATERIALS

(a) Definitions applicable to this section

(1) ***Aerated solid powders***. Aerated powders shall mean any powdered material used as a coating material which shall be fluidized within a container by passing air uniformly from below. It is common practice to fluidize such materials to form a fluidized powder bed and then dip the part to be coated into the bed in a manner similar to that used in liquid dipping. Such beds are also used as sources for powder spray operations.

(2) ***Spraying area***. Any area in which dangerous quantities of flammable vapors or mists, or combustible residues, dusts, or deposits are present due to the operation of spraying processes.

(3) ***Spray booth***. A power-ventilated structure provided to enclose or accommodate a spraying operation to confine and limit the escape of spray, vapor, and residue, and to safely conduct or direct them to an exhaust system.

(4) ***Waterwash spray booth***. A spray booth equipped with a water washing system designed to minimize dusts or residues entering exhaust ducts and to permit the recovery of overspray finishing material.

(5) ***Dry spray booth***. A spray booth not equipped with a water washing system as described in paragraph (a)(4) of this section. A dry spray booth may be equipped with (i) Distribution or baffle plates to promote an even flow of air through the booth or cause the deposit of overspray before it enters the exhaust duct; or (ii) Overspray dry filters to minimize dusts; or (iii) overspray dry filters to minimize dusts or residues entering exhaust ducts; or (iv) Overspray dry filter rolls designed to minimize dusts or residues entering exhaust ducts; or (v) Where dry powders are being sprayed, with powder collection systems so arranged in the exhaust to capture oversprayed material.

(6) ***Fluidized bed***. A container holding powder coating material which is aerated from below so as to form an air-supported expanded cloud of such material through which the preheated object to be coated is immersed and transported.

(7) ***Electrostatic fluidized bed***. A container holding powder coating material which is aerated from below so as to form an air-supported expanded cloud of such material which is electrically charged with a charge opposite to the charge of the object to be coated; such object is transported, through the container immediately above the charged and aerated materials in order to be coated.

(8) ***Approved***. Shall mean approved and listed by a nationally recognized testing laboratory. See 1910.7 for definition of nationally recognized testing laboratory.

(9) ***Listed***. See "approved" in 1910.107(a)(8).

(b) Spray booths

(1) Construction. Spray booths shall be substantially constructed of steel, securely and rigidly supported, or of concrete or masonry except that aluminum or other substantial noncombustible material may be used for

intermittent or low volume spraying. Spray booths shall be designed to sweep air currents toward the exhaust outlet.

(2) Interiors. The interior surfaces of spray booths shall be smooth and continuous without edges and otherwise designed to prevent pocketing of residues and facilitate cleaning and washing without injury.

(3) Floors. The floor surface of a spray booth and operator's working area, if combustible, shall be covered with noncombustible material of such character as to facilitate the safe cleaning and removal of residues.

(4) Distribution or baffle plates. Distribution or baffle plates, if installed to promote an even flow of air through the booth or cause the deposit of overspray before it enters the exhaust duct, shall be of noncombustible material and readily removable or accessible on both sides for cleaning. Such plates shall not be located in exhaust ducts.

(5) Dry type overspray collectors - (exhaust air filters). In conventional dry type spray booths, overspray dry filters or filter rolls, if installed, shall conform to the following:

(i) The spraying operations except electrostatic spraying operations shall be so designed, installed and maintained that the average air velocity over the open face of the booth (or booth cross section during spraying operations) shall be not less than 100 linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than 60 linear feet per minute, or more, depending on the volume of the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure activated devices shall be installed to indicate or insure that the required air velocity is maintained. Filter rolls shall be inspected to insure proper replacement of filter media.
STD 1-5.10

(ii) All discarded filter pads and filter rolls shall be immediately removed to a safe, well-detached location or placed in a water-filled metal container and disposed of at the close of the day's operation unless maintained completely in water.

(iii) The location of filters in a spray booth shall be so as to not reduce the effective booth enclosure of the articles being sprayed.

(iv) Space within the spray booth on the downstream and upstream sides of filters shall be protected with approved automatic sprinklers. STD 1-5.11

(v) Filters or filter rolls shall not be used when applying a spray material known to be highly susceptible to spontaneous heating and ignition.

(vi) Clean filters or filter rolls shall be noncombustible or of a type having a combustibility not in excess of class 2 filters as listed by Underwriters' Laboratories, Inc. Filters and filter rolls shall not be alternately used for different types of coating materials, where the combination of materials may be conducive to spontaneous ignition. See also paragraph (g)(6) of this section.

(6) Frontal area. Each spray booth having a frontal area larger than 9 square feet shall have a metal deflector or curtain not less than 2 1/2 inches (5.35 c.m) deep installed at the upper outer edge of the booth over the opening.

(7) Conveyors. Where conveyors are arranged to carry work into or out of spray booths, the openings therefor shall be as small as practical.

(8) Separation of operations. Each spray booth shall be separated from other operations by not less than 3 feet (0.912m.), or by a greater distance, or by such partition or wall as to reduce the danger from juxtaposition of hazardous operations. See also paragraph (c)(1) of this section.

(9) Cleaning. Spray booths shall be so installed that all portions are readily accessible for cleaning. A clear space of not less than 3 feet (0.912m.) on all sides shall be kept free from storage or combustible construction.

(10) Illumination. When spraying areas are illuminated through glass panels or other transparent materials, only fixed lighting units shall be used as a source of illumination. Panels shall effectively isolate the spraying area from the area in which the lighting unit is located, and shall be of a noncombustible material of such a nature or so protected that breakage will be unlikely. Panels shall be so arranged that normal accumulations of residue on the exposed surface of the panel will not be raised to a dangerous temperature by radiation or conduction from the source of illumination.

(c) Electrical and other sources of ignition

(1) Conformance. All electrical equipment, open flames and other sources of ignition shall conform to the requirements of this paragraph, except as follows:

(i) Electrostatic apparatus shall conform to the requirements of paragraphs (e) and (f) of this section;

(ii) Drying, curing, and fusion apparatus shall conform to the requirements of paragraph (g) of this section;

(iii) [reserved]

(iv) Powder coating equipment shall conform to the requirements of paragraph (c)(1) of this section.

(2) Minimum separation. There shall be no open flame or spark producing equipment in any spraying area nor within 20 feet (6.08.m) thereof, unless separated by a partition.

(3) Hot surfaces. Space-heating appliances, steampipes, or hot surfaces shall not be located in a spraying area where deposits of combustible residues may readily accumulate.

(4) Wiring conformance. Electrical wiring and equipment shall conform to the provisions of this paragraph and shall otherwise be in accordance with Subpart S of this part.

(5) Combustible residues, areas. Unless specifically approved for locations containing both deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area, whereon deposits of combustible residues may readily accumulate, except wiring in rigid conduit or in boxes or fittings containing no taps, splices, or terminal connections.

(6) Wiring type approved. Electrical wiring and equipment not subject to deposits of combustible residues but located in a spraying area as herein defined shall be of explosion-proof type approved for Class I, group D locations and shall otherwise conform to the provisions of Subpart S of this part, for Class I, Division 1, Hazardous Locations. Electrical wiring, motors, and other equipment outside of but within 20 feet (6.08m) of any spraying area, and not separated therefrom by partitions, shall not produce sparks under normal operating conditions and shall otherwise conform to the provisions of Subpart S of this part for Class I, Division 2

Hazardous Locations.

(7) Lamps. Electric lamps outside of, but within 20 feet (6.08m) of any spraying area, and not separated therefrom by a partition, shall be totally enclosed to prevent the falling of hot particles and shall be protected from mechanical injury by suitable guards or by location.

(8) Portable lamps. Portable electric lamps shall not be used in any spraying area during spraying operations. Portable electric lamps, if used during cleaning or repairing operations, shall be of the type approved for hazardous Class I locations.

(9) Grounding.

(i) All metal parts of spray booths, exhaust ducts, and piping systems conveying flammable or combustible liquids or aerated solids shall be properly electrically grounded in an effective and permanent manner.

(ii) [Reserved]

(d) Ventilation

(1) Conformance. Ventilating and exhaust systems shall be in accordance with the Standard for Blower and Exhaust Systems for Vapor Removal, NFPA No. 91-1961, where applicable and shall also conform to the provisions of this section.

(2) General. All spraying areas shall be provided with mechanical ventilation adequate to remove flammable vapors, mists, or powders to a safe location and to confine and control combustible residues so that life is not endangered. Mechanical ventilation shall be kept in operation at all times while spraying operations are being conducted and for a sufficient time thereafter to allow vapors from drying coated articles and drying finishing material residue to be exhausted.

(3) Independent exhaust. Each spray booth shall have an independent exhaust duct system discharging to the exterior of the building, except that multiple cabinet spray booths in which identical spray finishing material is used with a combined frontal area of not more than 18 square feet may have a common exhaust. If more than one fan serves one booth, all fans shall be so interconnected that one fan cannot operate without all fans being operated.

(4) Fan-rotating element. The fan-rotating element shall be nonferrous or nonsparking or the casing shall consist of or be lined with such material. There shall be ample clearance between the fan-rotating element and the fan casing to avoid a fire by friction, necessary allowance being made for ordinary expansion and loading to prevent contact between moving parts and the duct or fan housing. Fan blades shall be mounted on a shaft sufficiently heavy to maintain perfect alignment even when the blades of the fan are heavily loaded, the shaft preferably to have bearings outside the duct and booth. All bearings shall be of the self-lubricating type, or lubricated from the outside duct.

(5) Electric motors. Electric motors driving exhaust fans shall not be placed inside booths or ducts. See also paragraph (c) of this section.

(6) Belts. Belts shall not enter the duct or booth unless the belt and pulley within the duct or booth are thoroughly enclosed.

(7) Exhaust ducts. Exhaust ducts shall be constructed of steel and shall be substantially supported. Exhaust

ducts without dampers are preferred; however, if dampers are installed, they shall be maintained so that they will be in a full open position at all times the ventilating system is in operation.

(i) Exhaust ducts shall be protected against mechanical damage and have a clearance from unprotected combustible construction or other combustible material of not less than 18 inches(45.72cm).

(ii) If combustible construction is provided with the following protection applied to all surfaces within 18 inches(45.72 cm), clearances may be reduced to the distances indicated:

(a) 28-gage sheet metal on 1/4 -inch asbestos mill board	12 inches.
(b) 28-gage sheet metal on 1/8 -inch asbestos mill board spaced out 1 inch on noncombustible spacers	9 inches.
(c) 22-gage sheet metal on 1-inch rockwool batts reinforced with wire mesh or the equivalent	3 inches.
(d) Where ducts are protected with an approved automatic sprinkler system, properly maintained, the clearance required in subdivision (i) of this subparagraph may be reduced to 6 inches	

(8) Discharge clearance. Unless the spray booth exhaust duct terminal is from a water-wash spray booth, the terminal discharge point shall be not less than 6 feet from any combustible exterior wall or roof nor discharge in the direction of any combustible construction or unprotected opening in any noncombustible exterior wall within 25 feet(7.6m).

(9) Air exhaust. Air exhaust from spray operations shall not be directed so that it will contaminate makeup air being introduced into the spraying area or other ventilating intakes, nor directed so as to create a nuisance. Air exhausted from spray operations shall not be recirculated.

(10) Access doors. When necessary to facilitate cleaning, exhaust ducts shall be provided with an ample number of access doors.

(11) Room intakes. Air intake openings to rooms containing spray finishing operations shall be adequate for the efficient operation of exhaust fans and shall be so located as to minimize the creation of dead air pockets.

(12) Drying spaces. Freshly sprayed articles shall be dried only in spaces provided with adequate ventilation to prevent the formation of explosive vapors. In the event adequate and reliable ventilation is not provided such drying spaces shall be considered a spraying area. See also paragraph (j) of this section.

(e) Flammable and combustible liquids - storage and handling

(1) Conformance. The storage of flammable or combustible liquids in connection with spraying operations shall conform to the requirements of 1910.106, where applicable.

(2) Quantity. The quantity of flammable or combustible liquids kept in the vicinity of spraying operations shall be the minimum required for operations and should ordinarily not exceed a supply for 1 day or one shift. Bulk storage of portable containers of flammable or combustible liquids shall be in a separate, constructed building detached from other important buildings or cut off in a standard manner.

(3) Containers. Original closed containers, approved portable tanks, approved safety cans or a properly arranged system of piping shall be used for bringing flammable or combustible liquids into spray finishing room. Open or glass containers shall not be used.

(4) Transferring liquids. Except as provided in paragraph (e)(5) of this section the withdrawal of flammable and combustible liquids from containers having a capacity of greater than 60 gallons shall be by approved pumps. The withdrawal of flammable or combustible liquids from containers and the filling of containers, including portable mixing tanks, shall be done only in a suitable mixing room or in a spraying area when the ventilating system is in operation. Adequate precautions shall be taken to protect against liquid spillage and sources of ignition.

(5) Spraying containers. Containers supplying spray nozzles shall be of closed type or provided with metal covers kept closed. Containers not resting on floors shall be on metal supports or suspended by wire cables. Containers supplying spray nozzles by gravity flow shall not exceed 10 gallons capacity. Original shipping containers shall not be subject to air pressure for supplying spray nozzles. Containers under air pressure supplying spray nozzles shall be of limited capacity, not exceeding that necessary for 1 day's operation; shall be designed and approved for such use; shall be provided with a visible pressure gage; and shall be provided with a relief valve set to operate in conformance with the requirements of the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessel Code - 1968. Containers under air pressure supplying spray nozzles, air-storage tanks and coolers shall conform to the standards of the Code for Unfired Pressure Vessels, Section VIII of the ASME Boiler and Pressure Vessel Code - 1968 for construction, tests, and maintenance.

(6) Pipes and hoses.

(i) All containers or piping to which is attached a hose or flexible connection shall be provided with a shutoff valve at the connection. Such valves shall be kept shut when spraying operations are not being conducted.

(ii) When a pump is used to deliver products, automatic means shall be provided to prevent pressure in excess of the design working pressure of accessories, piping, and hose.

(iii) All pressure hose and couplings shall be inspected at regular intervals appropriate to this service. The hose and couplings shall be tested with the hose extended, and using the "inservice maximum operating pressures." Any hose showing material deteriorations, signs of leakage, or weakness in its carcass or at the couplings, shall be withdrawn from service and repaired or discarded.

(iv) Piping systems conveying flammable or combustible liquids shall be of steel or other material having comparable properties of resistance to heat and physical damage. Piping systems shall be properly bonded and grounded.

(7) Spray liquid heaters. Electrically powered spray liquid heaters shall be approved and listed for the specific

location in which used (see paragraph (c) of this section). Heaters shall not be located in spray booths nor other locations subject to the accumulation of deposits or combustible residue. If an electric motor is used, see paragraph (c) of this section.

(8) Pump relief. If flammable or combustible liquids are supplied to spray nozzles by positive displacement pumps, the pump discharge line shall be provided with an approved relief valve discharging to a pump suction or a safe detached location, or a device provided to stop the prime mover if the discharge pressure exceeds the safe operating pressure of the system.

(9) Grounding. Whenever flammable or combustible liquids are transferred from one container to another, both containers shall be effectively bonded and grounded to prevent discharge sparks of static electricity.

(f) Protection

(1) Conformance. In sprinklered buildings, the automatic sprinkler system in rooms containing spray finishing operations shall conform to the requirements of 1910.159. In unsprinklered buildings where sprinklers are installed only to protect spraying areas, the installation shall conform to such standards insofar as they are applicable. Sprinkler heads shall be located so as to provide water distribution throughout the entire booth.
STD 1-5.11

(2) Valve access. Automatic sprinklers protecting each spray booth (together with its connecting exhaust) shall be under an accessibly located separate outside stem and yoke (OS&Y) subcontrol valve.

(3) Cleaning of heads. Sprinklers protecting spraying areas shall be kept as free from deposits as practical by cleaning daily if necessary. (See also paragraph (g) of this section.)

(4) Portable extinguishers. An adequate supply of suitable portable fire extinguishers shall be installed near all spraying areas.

(g) Operations and maintenance

(1) Spraying. Spraying shall not be conducted outside of predetermined spraying areas.

(2) Cleaning. All spraying areas shall be kept as free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily if necessary. Scrapers, spuds, or other such tools used for cleaning purposes shall be of nonsparking material.

(3) Residue disposal. Residue scrapings and debris contaminated with residue shall be immediately removed from the premises and properly disposed of. Approved metal waste cans shall be provided wherever rags or waste are impregnated with finishing material and all such rags or waste deposited therein immediately after use. The contents of waste cans shall be properly disposed of at least once daily or at the end of each shift.
STD 1-5.13

(4) Clothing storage. Spray finishing employees' clothing shall not be left on the premises overnight unless kept in metal lockers.

(5) Cleaning solvents. The use of solvents for cleaning operations shall be restricted to those having flashpoints not less than 100 deg. F.; however, for cleaning spray nozzles and auxiliary equipment, solvents having flashpoints not less than those normally used in spray operations may be used. Such cleaning shall be conducted inside spray booths and ventilating equipment operated during cleaning.

(6) Hazardous materials combinations. Spray booths shall not be alternately used for different types of coating materials, where the combination of the materials may be conducive to spontaneous ignition, unless all deposits of the first used material are removed from the booth and exhaust ducts prior to spraying with the second used material.

(7) "No Smoking" signs. "No smoking" signs in large letters on contrasting color background shall be conspicuously posted at all spraying areas and paint storage rooms.

(e) Fixed electrostatic apparatus

(1) Conformance. Where installation and use of electrostatic spraying equipment is used, such installation and use shall conform to all other paragraphs of this section, and shall also conform to the requirements of this paragraph.

(2) Type approval. Electrostatic apparatus and devices used in connection with coating operations shall be of approved types.

(3) Location. Transformers, power packs, control apparatus, and all other electrical portions of the equipment, with the exception of high-voltage grids, electrodes, and electrostatic atomizing heads and their connections, shall be located outside of the spraying area, or shall otherwise conform to the requirements of paragraph (c) of this section.

(4) Support. Electrodes and electrostatic atomizing heads shall be adequately supported in permanent locations and shall be effectively insulated from the ground. Electrodes and electrostatic atomizing heads which are permanently attached to their bases, supports, or reciprocators, shall be deemed to comply with this section. Insulators shall be nonporous and noncombustible.

(5) Insulators, grounding. High-voltage leads to electrodes shall be properly insulated and protected from mechanical injury or exposure to destructive chemicals. Electrostatic atomizing heads shall be effectively and permanently supported on suitable insulators and shall be effectively guarded against accidental contact or grounding. An automatic means shall be provided for grounding the electrode system when it is electrically deenergized for any reason. All insulators shall be kept clean and dry.

(6) Safe distance. A safe distance shall be maintained between goods being painted and electrodes or electrostatic atomizing heads or conductors of at least twice the sparking distance. A suitable sign indicating this safe distance shall be conspicuously posted near the assembly.

(7) Conveyors required. Goods being painted using this process are to be supported on conveyors. The conveyors shall be so arranged as to maintain safe distances between the goods and the electrodes or electrostatic atomizing heads at all times. Any irregularly shaped or other goods subject to possible swinging or movement shall be rigidly supported to prevent such swinging or movement which would reduce the clearance to less than that specified in paragraph (e)(6) of this section.

(8) Prohibition. This process is not acceptable where goods being coated are manipulated by hand. When finishing materials are applied by electrostatic equipment which is manipulated by hand, see paragraph (f) of this section for applicable requirements.

(9) Fail-safe controls. Electrostatic apparatus shall be equipped with automatic controls which will operate without time delay to disconnect the power supply to the high voltage transformer and to signal the operator

under any of the following conditions:

(i) Stoppage of ventilating fans or failure of ventilating equipment from any cause.

(ii) Stoppage of the conveyor carrying goods through the high voltage field.

(iii) Occurrence of a ground or of an imminent ground at any point on the high voltage system.

(iv) Reduction of clearance below that specified in paragraph (e)(6) of this section.

(10) Guarding. Adequate booths, fencing, railings, or guards shall be so placed about the equipment that they, either by their location or character or both, assure that a safe isolation of the process is maintained from plant storage or personnel. Such railings, fencing, and guards shall be of conducting material, adequately grounded.

(11) Ventilation. Where electrostatic atomization is used the spraying area shall be so ventilated as to insure safe conditions from a fire and health standpoint.

(12) Fire protection. All areas used for spraying, including the interior of the booth, shall be protected by automatic sprinklers where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment shall be provided.
STD 1-5.1

(f) Electrostatic hand spraying equipment

(1) Application. This paragraph shall apply to any equipment using electrostatically charged elements for the atomization and/or, precipitation of materials for coatings on articles, or for other similar purposes in which the atomizing device is hand held and manipulated during the spraying operation.

(2) Conformance. Electrostatic hand spraying equipment shall conform with the other provisions of this section.

(3) Equipment approval and specifications. Electrostatic hand spray apparatus and devices used in connection with coating operations shall be of approved types. The high voltage circuits shall be designed so as to not produce a spark of sufficient intensity to ignite any vapor-air mixtures nor result in appreciable shock hazard upon coming in contact with a grounded object under all normal operating conditions. The electrostatically charged exposed elements of the handgun shall be capable of being energized only by a switch which also controls the coating material supply.

(4) Electrical support equipment. Transformers, powerpacks, control apparatus, and all other electrical portions of the equipment, with the exception of the handgun itself and its connections to the power supply shall be located outside of the spraying area or shall otherwise conform to the requirements of paragraph (c) of this section.

(5) Spray gun ground. The handle of the spraying gun shall be electrically connected to ground by a metallic connection and to be so constructed that the operator in normal operating position is in intimate electrical contact with the grounded handle.

(6) Grounding - general. All electrically conductive objects in the spraying area shall be adequately grounded. This requirement shall apply to paint containers, wash cans, and any other objects or devices in the area. The equipment shall carry a prominent permanently installed warning regarding the necessity for this grounding

feature.

(7) Maintenance of grounds. Objects being painted or coated shall be maintained in metallic contact with the conveyor or other grounded support. Hooks shall be regularly cleaned to insure this contact and areas of contact shall be sharp points or knife edges where possible. Points of support of the object shall be concealed from random spray where feasible and where the objects being sprayed are supported from a conveyor, the point of attachment to the conveyor shall be so located as to not collect spray material during normal operation.

(8) Interlocks. The electrical equipment shall be so interlocked with the ventilation of the spraying area that the equipment cannot be operated unless the ventilation fans are in operation.

(9) Ventilation. The spraying operation shall take place within a spray area which is adequately ventilated to remove solvent vapors released from the operation.

(g) Drying, curing, or fusion apparatus

(1) Conformance. Drying, curing, or fusion apparatus in connection with spray application of flammable and combustible finishes shall conform to the Standard for Ovens and Furnaces, NFPA 86A-1969, where applicable and shall also conform with the following requirements of this paragraph.

(2) Alternate use prohibited. Spray booths, rooms, or other enclosures used for spraying operations shall not alternately be used for the purpose of drying by any arrangement which will cause a material increase in the surface temperature of the spray booth, room, or enclosure.

(3) Adjacent system interlocked. Except as specifically provided in paragraph (g)(4) of this section, drying, curing, or fusion units utilizing a heating system having open flames or which may produce sparks shall not be installed in a spraying area, but may be installed adjacent thereto when equipped with an interlocked ventilating system arranged to:

(i) Thoroughly ventilate the drying space before the heating system can be started;

(ii) Maintain a safe atmosphere at any source of ignition;

(iii) Automatically shut down the heating system in the event of failure of the ventilating system.

(4) Alternate use permitted. Automobile refinishing spray booths or enclosures, otherwise installed and maintained in full conformity with this section, may alternately be used for drying with portable electrical infrared drying apparatus when conforming with the following:

(i) Interior (especially floors) of spray enclosures shall be kept free of overspray deposits.

(ii) During spray operations, the drying apparatus and electrical connections and wiring thereto shall not be located within spray enclosure nor in any other location where spray residues may be deposited thereon.

(iii) The spraying apparatus, the drying apparatus, and the ventilating system of the spray enclosure shall be equipped with suitable interlocks so arranged that:

(a) The spraying apparatus cannot be operated while the drying apparatus is inside the spray enclosure.

(b) The spray enclosure will be purged of spray vapors for a period of not less than 3 minutes before the drying apparatus can be energized.

(c) The ventilating system will maintain a safe atmosphere within the enclosure during the drying process and the drying apparatus will automatically shut off in the event of failure of the ventilating system.

(iv) All electrical wiring and equipment of the drying apparatus shall conform with the applicable sections of Subpart S of this part. Only equipment of a type approved for Class I, Division 2 hazardous locations shall be located within 18 inches (45.72cm) of floor level. All metallic parts of the drying apparatus shall be properly electrically bonded and grounded.

(v) The drying apparatus shall contain a prominently located, permanently attached warning sign indicating that ventilation should be maintained during the drying period and that spraying should not be conducted in the vicinity that spray will deposit on apparatus.